Agenda for HHS Public Health Activities (for Fiscal Years 1999 and 2000) at U.S. Department of Energy Sites

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U.S. Department of Energy
Office of Health Studies

and

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Centers for Disease Control and Prevention
National Center for Environmental Health
National Institute for Occupational Safety and Health

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Introduction

This Agenda for Public Health Activities for Fiscal Year 2000 at Department of Energy Sites was developed by the U.S. Department of Health and Human Services (HHS) and the U.S. Department of Energy (DOE) Office of Health Studies. Suggestions for HHS health studies and public health activities for DOE and the priorities involved were provided by HHS committees chartered under the Federal Advisory Committee Act (FACA) for the Fernald, Hanford, Idaho National Engineering and Environmental Laboratory, and Savannah River sites. Open public meetings were specifically convened in 1997 and 1998 to gather suggestions and feedback on health studies and public health activities at three DOE sites: Los Alamos, Oak Ridge, and Rocky Flats. Input was received from individuals at other public meetings at these and other DOE sites. A draft agenda was prepared and public comment sought. Notice of the agenda was published in the Federal Register in April 1999 and comments from 54 individuals or groups were received. The final agenda reflects input from the above noted sources as well as comments received that are pertinent to the development of a consolidated and coordinated health studies and public health activities strategy for DOE workers and surrounding communities. DOE and HHS are actively examining means by which to increase future public participation.

This agenda is not meant to provide a complete review of the literature, but instead to provide some background for the proposed activities. It focuses primarily on current and future activities conducted under the agreement. Conduct of activities on the agenda is always dependent upon funding levels made available by Congress. The opinions reflect those of the specific agency conducting the activity.

Background

Energy-related health studies and public health activities conducted by the National Center for Environmental Health (NCEH), the National Institute for Occupational Safety and Health (NIOSH), and the Agency for Toxic Substances and Disease Registry (ATSDR) are accomplished under a Memorandum of Understanding (MOU) with HHS. The DOE Office of Environment, Safety and Health (EH) is responsible for management of the MOU. A moratorium is currently in place on destruction of any DOE records that might be useful in the conduct of health studies or public health activities.

Overview of activities, gaps in knowledge, and general plans

Health-related research and public health activities are occurring at numerous sites. Not all sites have research or public health activities either ongoing or planned. Research findings and observations by workers, management, and other stakeholders have identified some gaps in knowledge that are both general to DOE complex-wide and specific to sites including some not in this agenda. This agenda attempts to address the gaps where identified.

Organization of the agenda

The agenda is organized according to general information and overall gaps in knowledge about health effects of hazards at DOE sites and then alphabetically by the DOE site for which specific public health activities and/or research are planned. The last sections of the document describe (1) single and/or multisite worker studies proposed by NIOSH, but for which sites cannot be selected until additional evaluation is carried out to determine the best locations for conducting the studies, and (2) multisite studies by ATSDR. Information is stratified within each site plan as follows:

- General background information on the site
- Information learned from previous studies and assessments
- Current health research and public health activities being conducted by HHS
- A comparison between current knowledge and important issues that might need to be addressed
- Proposed new activities for fiscal year 2000

Each of these topics is further divided according to community, environmental, and worker issues, although many of these categories overlap.

General Information and Overall Gaps in Knowledge

Scientific opinions regarding the magnitude of risk associated with chronic low-level radiation exposure are polarized and the subject of ongoing debate. The contribution of risks to workers and members of the communities around DOE sites from exposures to chemical hazards and combinations of chemicals and radioactive materials has not been well described. For many vitally important reasons, the next decade is the best possible time to study low-level radiation exposure, and any association of chemical and complex chemical/radiological exposures among the DOE workforce and in surrounding communities.

- Findings may be relevant not only to former workers, but also to 300,000 current DOE nuclear-facility workers, to the 1.5 million current U.S. radiation workers in other industries including nuclear energy and the medical field, and to understanding risk to members of the communities around DOE sites,

- Findings may help resolve the controversy surrounding low-level chronic exposure and linear no-threshold risk models,

- Findings would respond to concerns and interests of stakeholders such as risks from chemicals and combination chemical/radioactive hazards exposures,

- An important window of opportunity of limited duration for DOE records and institutional memory is currently available,

- Latency periods for development of health effects in workers and communities are sufficiently long in most cases to conduct meaningful health studies.

It is important to recognize that no single study will remove all extant uncertainty from the current risk estimates. Only through the collective evaluation of multiple studies may the true relationship of health effects from these exposures be discovered and appropriately characterized. For example, recent occupational studies have shown findings of a dose-response relationship between external radiation dose and the risk of mortality from lung cancer (Fernald) and leukemia (Savannah River). Also, the recent multi-national study by the International Agency for Research on Cancer (IARC) showed a dose-response relationship for external radiation and leukemia.

Currently, a recognized need for the following general activities exists. This list should not be considered a final and/or comprehensive list addressing all general research opportunities or knowledge gaps.

- Further epidemiologic research is needed to evaluate current occupational radiation exposure limits. Many of these exposure limits were developed from bomb survivor and

radiation therapy exposure data that differs in intensity, duration, route of exposure, and frequency from that found in the workplace.

- The relationship between internal radiation dose and health effects needs to be evaluated.

- Results from ongoing mortality studies need to be evaluated to improve understanding of the causes of cancer and chronic diseases. Additional studies can be proposed to focus on a single disease in worker groups, such as previously reported excesses of multiple myeloma and Hodgkin's Disease.

- There is a need to ensure that complete records, including industrial hygiene and work history data for the various levels of subcontractors at each site, are available.

- Lists of sentinel health events for radiation communities and training programs should be provided to primary care providers.

- As significant exposures are identified, community members and health professionals need educational information concerning risks and potential health effects.

- Subcontractor workers and clean-up workers, as well as their respective exposures, need better characterization and documentation.

- Health effects of simultaneous exposures to low levels of chemicals and/or radiation and other risk factors should be addressed among workers.

Public Health Activities Site Plan

Brookhaven National Laboratory

Upton, New York

Background

The Brookhaven National Laboratory (BNL) consists of slightly more than 8 square miles (5,265 acres) near the center of Long Island, about 60 miles east of New York City. The surrounding area is heavily populated, with more than 1.5 million people living in Suffolk County.

Brookhaven is an active site. The ongoing mission of Brookhaven is to carry out basic and applied research in the following fields: high-energy nuclear and solid state physics; fundamental material and structure properties and the interactions of matter; nuclear medicine; biological effects of ionizing radiation; medical uses of radionuclides and ionizing radiation; biomedical and environmental sciences; and selected energy technologies. The site was used by the Army as Camp Upton during World Wars I and II. BNL was operated from 1947–1998 by Associated Universities, Inc., under contract first to the Atomic Energy Commission and now to the Department of Energy (DOE). The facility is now operated by Brookhaven Science Associates, under contract to DOE.

Past practices at BNL have resulted in on-site and off-site groundwater contamination with radionuclides, such as, tritium and strontium-90. An Interagency Agreement signed in 1992 by the U.S. Environmental Protection Agency, the New York State Department of Environmental Conservation, and the DOE governs the environmental restoration program. Suffolk County and the public play an active role in the decision-making process. The site is removing or immobilizing sources of groundwater contamination, and treating groundwater to remove contaminants.

The community is concerned about groundwater contamination, the existence of radionuclides in on-site soils, off-site contamination in the Peconic River, and the effects of radioactive air emissions resulting from past and present facility operations. The discovery of a tritium leak from the spent fuel pool of one of the two operating research reactors created a heightened awareness and interest in BNL activities by community and special interest groups. The association between increased incidence of cancer, especially breast cancer on Long Island, and air releases of radionuclides from the site's reactors is a community health concern.

What have we learned from our studies and assessments of BNL?

Off-Site Contamination

- A **health consultation** by the Agency for Toxic Substances and Disease Registry (ATSDR), which focused on groundwater, concluded that sampling results of residential wells do not indicate that individuals are being exposed to contaminant levels that would cause adverse health effects. In 1995, plumes of groundwater contaminated with volatile organic compounds (VOCs), including carbon tetrachloride, were found off-site. Further characterization found the contamination to have migrated approximately 7,500 feet south of the site boundary. The plumes become deeper as the distance from the source areas increases. Contaminants are generally deeper than residential wells in the area. A plume of lower concentration VOCs, predominantly trichloroethylene, extends approximately 4,000 feet east of the site boundary. The source of contaminant is historical releases from the BNL sewage treatment plant. While low levels of tritium have been detected off-site, no monitoring of wells or residential well samples have been above the drinking water standard for any radionuclide.

- As a precautionary measure, DOE has offered to test the water in **existing private wells** that might be affected and, at the homeowner's option, connect residences to the public water supply. DOE, in conjunction with the Suffolk County Department of Health Services, has connected approximately 1,500 residences to the public water supply.

Community Health Studies and Activities

- A 1994 study by the New York State Department of Health found elevated risks for **postmenopausal breast cancer** among women living close to chemical facilities in Nassau County. Although BNL is not located in Nassau County, community and activist groups are concerned about BNL's possible contribution to increased incidence of breast cancer.

- A limited study commissioned by the Suffolk County legislature assessed the **geographic patterns** of cancers and congenital malformations in relation to BNL. Cancer rates for all types of cancers studied, including childhood cancers, were not elevated near the laboratory, and there was no evidence that rates differed by sector or were correlated with underground plume or wind direction. Malformation rates were similar between Suffolk County and other areas except for congenital hip dislocation, which was higher in Suffolk County but similar to the rate of upstate New York. The rate of female breast cancer was elevated on the east end of Long Island, but was not attributed to BNL.

Studies of the Health of BNL Workers

- There is no epidemiologic research that compares the health of workers at BNL to other populations.

What are the current studies and public health activities at BNL?

Community Involvement

- As part of the public health assessment process, ATSDR is working with DOE and local community members and organizations (for example, homeowners' associations from the Yaphank, Manorsville, Longwood, Brookhaven, and Middle Island communities; and two activist groups: the Citizens Campaign for the Environment and Environmental Advocates of Long Island) to **determine priorities**. The community has requested health consultations on groundwater contamination and air quality. ATSDR has completed the groundwater health consultation and presented its findings to the Brookhaven Executive Roundtable. ATSDR staff have requested air data from BNL, and DOE is compiling data for laboratory air emissions prior to 1962.

Off-Site Contamination

- ATSDR is preparing a **public health assessment** of the public health impact from releases of hazardous materials from the site. Potential exposure pathways include on-site and off-site groundwater contaminated with VOCs, and on-site groundwater contaminated with radionuclides. Air releases are also being considered in the public health assessment process. In addition, community health concerns, such as incidence of rhabdomyosarcoma, and health outcome data for the area are being evaluated.

Community Health Studies and Activities

- The **Long Island Breast Cancer Study Project** is a multistudy effort to investigate whether environmental factors are responsible for breast cancer in Tolland County, Connecticut, and in the New York counties of Nassau, Schoharie, and Suffolk. The study began in 1993 and is funded and coordinated by the National Cancer Institute in coordination with the National Institute for Environmental Health Sciences.

Occupational Health Studies

- DOE, in conjunction with the New York State Cancer Registry, is assessing the distribution of cancer among workers.

What are the gaps in our knowledge and what important issues need to be addressed?

- Community groups have requested an in-depth epidemiologic study of workers.
- There is community concern about rhabdomyosarcoma in relationship to BNL.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- The National Institute for Occupational Safety and Health (NIOSH) plans to conduct a **walk-through survey** of Brookhaven, including an initial assessment of records and other information needed to determine the feasibility and necessity of future worker studies.

Public Health Activities Site Plan

Energy Technology Engineering Center (Santa Susana Field Laboratory)

Simi Valley, California

Background

The Santa Susana Field Laboratory (SSFL) was established in 1946 in the Simi Valley, Ventura County, California, to test rocket engines. North American Aviation (now Boeing North American) established the Rocketdyne Division in 1955 to operate the SSFL. North American Aviation operated most of the facilities after 1947 and since 1954, has owned much of the SSFL land. Of the SSFL's 2,700 acres, the Department of Energy (DOE) lease-options a small part of Area IV, known as the Energy Technology Engineering Center (ETEC). The center consists of Government-owned buildings on 90 acres of land owned by Rocketdyne.

When ETEC opened in the late 1950s, the site was used to develop security-sensitive projects involving hazardous materials. These projects supported nuclear research and energy development projects for DOE and its predecessor agency. The ETEC site includes buildings used for auxiliary support facilities, mechanical and chemical test facilities, offices, and the testing of apparatus for large-scale heat transfer and fluid mechanics experiments. There are no longer any DOE-funded research and development activities at the site.

What have we learned from our studies and assessments of SSFL and ETEC?

Off-Site Contamination

- The site has a number of **buildings and areas contaminated** with chemical and radioactive substances. This contamination may exist in the air, groundwater, soil, structures, and surface water. Some testing procedures and the sodium disposal facility have been identified as the sources of some off-site contamination, including contamination with tritium and other radionuclides. Off-site radionuclides that exceeded background concentrations include cesium-137, plutonium-238, strontium-90, and tritium.

Community Health Studies and Activities

- The California Department of Health Services conducted a cancer incidence study in the Los Angeles County census tracts near SSFL for the period 1978–1989. For the period 1983–88, male residents residing near SSFL were at increased risk for

developing cancers classified as possibly due to radiation, and in particular, for bladder cancer.

- In 1997, the Tri-Counties Regional Cancer Registry performed a preliminary analysis on 1988–1995 cancer incidence among Ventura county residents living within a five-mile radius of SSFL. A significant increase in lung cancer was reported for the combined group of men and women. However, this increase was small, and lung cancer was not significantly increased in men or women separately. This preliminary analysis also reported a significant decrease in the leukemia incidence in women.

Studies of the Health of SSFL/ETEC Workers

- The University of California at Los Angeles conducted two epidemiologic studies of workers employed at Rocketdyne/Atomics International in Ventura County, CA. Many of these workers were assigned to SSFL. The first study was of mortality among workers monitored for exposure to ionizing radiation. The second study was an in-depth analysis of mortality among workers exposed to asbestos and the rocket fuel, monomethyl hydrazine.

  The radiation study concluded that employees exposed to higher lifetime doses of external ionizing radiation had an increased risk of dying from cancers of the blood and lymphatic system, and from lung cancer. Among workers who were monitored for internal radiation, those who received higher lifetime doses had a significantly higher risk of dying from cancers of the blood and lymphatic system and cancers of the esophagus, oral cavity, pharynx, and stomach.

  In the second study, asbestos exposures were evaluated for radiation monitored workers. The study concluded that the higher risk of lung cancer seen for these workers was not due to asbestos exposure. Workers exposed to the highest levels of hydrazine in the 1960s had a higher risk of lung cancer relative to those with the lowest exposures.

What are the current studies and public health activities at SSFL/ETEC?

Community Involvement

- As part of the funding from DOE, which ended in FY 1999, the State of California established an **oversight panel** of citizens and scientists for the study of Rocketdyne workers. The oversight panel has recommended that a community health study be conducted.

- ATSDR held public availability sessions at three different locations in the area in fall 1999, to gather information on the health concerns of community members. More

than 250 community members attended those meetings, and other community members have presented ATSDR with written comments and concerns.

Off-Site Contamination

- The California Department of Toxic Substances Control (DTSC) has indicated that off-site contamination studies may be required as part of the Resource Conservation and Recovery Act Facility Investigation for the site. In addition, at the last meeting of the SSFL Work Group, the Environmental Protection Agency and DTSC stated that they would be willing to consider additional off-site sampling.

Community Health Studies and Activities

- In response to petition requests from Senators Diane Feinstein and Barbara Boxer, and Representative Elton Gallegly, ATSDR released a draft preliminary site evaluation in December 1999, which addressed the concerns of the community and presented a preliminary assessment of the potential for adverse human health effects from past, present, and future activities at the site based on currently available information. The preliminary site evaluation recommended specific follow up activities.

Occupational Health Studies

- No occupational health studies are currently in progress.

What are the gaps in our knowledge and what important issues need to be addressed?

- There is a need for a more in-depth evaluation of exposure pathways that addresses past, current, and future exposure to chemicals and radionuclides from the SSFL. The assessment should address the following related issues:

    - Development of a regional hydrogeological flow model and additional monitoring at down-gradient springs or seeps in Simi Valley and Santa Susana Knolls to evaluate the potential for deep fracture flow and potential future exposure.

    - Additional radiological characterization of Area IV with more sensitive instrumentation and appropriate grid spacing to assure a lower detection limit.

    - More in depth evaluation of airborne chemical releases from SSFL operations, including air dispersion modeling of past accidents and disposal activities, and compilation and use of a consistent, site-specific meteorological dataset to improve the assessment of past exposures to these substances.

- A re-analysis of the cancer registry data, including additional years of newly available cancer data and updated demographic information, to determine if the apparent increase in the incidence rates of bladder and lung cancers persist.

Proposed Activities

New Activities for FY 1999 and FY 2000

- In December 1999, ATSDR completed a Draft Preliminary Site Evaluation for the SSFL. ATSDR plans to coordinate a public health action plan to provide a more in-depth evaluation of exposure pathways that will address the gaps identified in the preliminary site evaluation.

Public Health Activities Site Plan

Fernald Environmental Management Project

Fernald, Ohio

Background

The Feed Materials Production Center (FMPC) was a Department of Energy (DOE) facility located near Fernald, Ohio, about 18 miles northwest of Cincinnati. During its years of operation, from 1951–1988, the facility was involved in a number of activities related to uranium production and processing. Specifically, the facility produced highly purified uranium metal products that were used as feed materials in DOE production reactors. After production stopped in 1988, the site was renamed the Fernald Environmental Management Project (FEMP). DOE and its contractor now devote all efforts to decommissioning and cleanup of the site.

During its more than 40 years of operation, the facility released radioactive and hazardous materials to the environment. The materials were primarily uranium, radon, and radon decay products. Releases occurred during routine plant operations and waste management and storage activities. Four large concrete silos, constructed in 1952 while the facility was operating, store radioactive residues from former uranium processing activities. Two of these, called the K-65 silos, contain high radium-bearing residues. As part of the site cleanup, the silo residues are being removed, processed, and shipped off the site for permanent disposal sometime after 2007. Emissions from the K-65 silos have been a significant source of radon exposure to workers and residents. In 1991, bentonite clay was injected into the silos to cap the residues and reduce radon emissions. The radioactive wastes stored at the site and the historical releases to the environment have led to health concerns among communities and workers.

What have we learned from our studies and assessments of Fernald?

Off-Site Contamination

- Studies by the Center for Disease Control and Prevention's National Center for Environmental Health (NCEH) have shown that past inhalation of radon and radon progeny from the silos (prior to capping with bentonite) was a major contributor to radiation dose. Other contributors included uranium, thorium, and other radionuclides. The NCEH **Fernald Dosimetry Reconstruction Project** estimated releases of radiation materials from past operations at the Fernald site and the potential effects of those releases on off-site residents.

- The **Fernald Risk Assessment Project** was undertaken to characterize the human health risk that may be associated with past exposures to radioactive materials that were released from the FMPC while it was operating. The project was undertaken to address community health concerns and to assist in evaluating the feasibility of an epidemiologic study within the community. The first phase of this project provided estimates of the impact of the former FMPC on lung cancer mortality. The study reported that the estimated number of lung cancer deaths occurring between 1951 and 2088 may be increased by 1% to 12% as a result of FMPC-related radiation exposure. Exposure to radon and radon progeny accounted for most of the estimated total lung dose.

- **Residential radon monitoring** was conducted in the area. Public concern about whether bentonite caps on the K-65 silos effectively controlled radon emissions prompted the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency's (EPA) National Air and Radiation Environmental Laboratory (NAREL) to monitor radon levels in residences near the site. Two sets of indoor radon measurements were made from 1993–1994. The radon levels measured in most homes were below the EPA's recommended action level of 4 picocuries per liter (pCi/L). Therefore, they were considered typical of naturally occurring radon and not indicative of increased radon emissions from the site. ATSDR notified residents of homes with radon levels greater than 4 pCi/L and provided information about radon sources and abatement.

- **Radon levels are being monitored in ambient air off the site**. In response to public concern about radon releases from the K-65 silos and other sources on the site, ATSDR and NAREL have been monitoring radon levels in ambient air off site of the Fernald facility since 1993. ATSDR concluded that despite increases in on-site radon emissions over time, radon measured in off-site air has been relatively constant and at levels considered typical of naturally occurring radon. An ATSDR health consultation summarizes the findings of radon monitoring from December 1993 to June 1994.

- An ATSDR health consultation concluded that levels of **radionuclides in locally produced milk** do not pose a public health hazard.

- An ATSDR health consultation concluded that **levels of radionuclides associated with locally grown produce** do not pose a public health hazard.

- An ATSDR health consultation confirmed that using groundwater for non-drinking water uses does not pose a health hazard from radionuclides.

Community Health Studies and Activities

- ATSDR provided **health education** for Fernald area health professionals in November 1998. The program provided information and education about industrial processes at Fernald, historical and current radiological and chemical exposures to workers and residents, the results of NCEH's lung cancer risk assessment, and resources for health care providers and physicians. Representatives from the University of Cincinnati, Mercy Health Partners, the Fernald Health Effects Subcommittee, the National Institute for Occupational Safety and Health (NIOSH), and ATSDR participated in the program.

Studies of the Health of Fernald Workers

- The mortality experience of 4,014 white male workers hired at Fernald from 1951–1981 was studied. Hourly workers had higher death rates than the general population for combined cancers, lung cancer, and motor vehicle accidents. Salaried workers had a higher rate of death from stomach cancer. Lung cancer death rates increased as radiation dose increased, and noncancerous respiratory disease mortality increased with internal radiation dose.

- Fifty-one Fernald workers were included in a multisite study of lung cancer mortality and uranium dust exposure at four uranium processing operations. Specific results for Fernald were not reported. Overall, a higher risk of lung cancer was reported for workers first hired at age 45 years and older.

- A second study of white males hired from 1952–1972, reported a higher illness rate than expected for noncancerous respiratory diseases. Workers older than 45 years at the time of illness appear to have the highest rate of respiratory disease.

What are the current studies and public health activities at Fernald?

Community Involvement

- ATSDR, NCEH, and NIOSH established the **Fernald Health Effects Subcommittee** (HES) to seek stakeholder input into health-related activities for the Fernald site. The subcommittee provides invaluable advice and guidance to all Fernald-related research and public health activities of the agencies.

- NCEH, in collaboration with subcommittee members, NIOSH, and ATSDR, is evaluating the current HESs, including the Fernald HES, to examine how well these community and agency partnerships are working and to identify how to better improve stakeholder involvement through the subcommittee process.

Off-Site Contamination

- ATSDR is conducting a **public health assessment** of the Fernald site. ATSDR will use information reported by NCEH's Dosimetry Reconstruction Project and Risk Assessment Project to address the off-site population's past exposure to radionuclides. ATSDR may also use environmental data included in the Fernald site-wide environmental database and other sources (for example, the Fernald Medical Monitoring Program and NIOSH's exposure assessment of workers) to evaluate past and current exposure to radionuclides and chemicals.

- ATSDR plans to continue **monitoring radon in ambient air** near the Fernald site during the remediation process.

Community Health Studies and Activities

- ATSDR is coordinating a University of Cincinnati contract to examine morbidity data from the first medical **examination of the Fernald Medical Monitoring Program, to determine if prevalence of certain noncancer diagnoses was greater than expected**. Laboratory data from urine and blood bio-specimens also will be evaluated. This project also will assess the utility of the Fernald Medical Monitoring Program database for future research.

- NCEH is proceeding with the next phase of its Risk Assessment Project which will estimate the **impact of historic off-site exposures to radioactive materials** from the site on the risk of other cancers.

- NCEH is continuing to assess the **feasibility of conducting an epidemiologic study** in the Fernald community to evaluate the health impact of past releases of radioactive materials from the site.

- ATSDR will continue to provide **health care provider training** in the Fernald community. A second health education program is scheduled for February 2000.

Occupational Health Studies

- Exposures encountered at Fernald and other sites by **decontamination and decommissioning (D&D) workers** are being characterized by NIOSH. Working conditions and research needs are being identified at each study site. These results are relevant to current workers, and support development of surveillance activities.

- NIOSH is conducting a feasibility study for developing **a registry for health and work histories information** for current D&D workers across DOE sites, including

Fernald. If feasible, work history, radiologic, industrial hygiene, and medical data will be collected for each current worker, including subcontractors. This information can be used in future health studies.

- NIOSH is updating and expanding the **mortality study of Fernald workers**. In addition to the studies of white males hired at Fernald from 1951–1981, females, nonwhites, and workers employed from 1981–1989 will be included.

- NIOSH is conducting an **exposure assessment** for previous Fernald workers. Radiation and chemical exposures will be studied. Special attention will be paid to worker exposures to acid mists, asbestos, radon, and uranium dust. The findings from this work will add new exposure information to the ongoing Fernald mortality study.

- Sponsored by a NIOSH grant, the State University of New York is conducting a **mortality study of female nuclear workers** at 12 facilities, including Fernald. This study will be the largest study of mortality among the 80,000 women ever employed in the DOE workforce. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

What are the gaps in our knowledge and what are the important issues that need to be addressed?

- To address community concerns about the storage of radon in the K-65 silos, there is a need to evaluate potential exposures to radionuclides if a catastrophic event (for example, an earthquake or tornado) occurs and disrupts the integrity of the K-65 silos.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously. New activities will be initiated only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

No new activities are proposed.

Public Health Activities Site Plan

Hanford

Richland, Washington

Background

The Hanford Nuclear Reservation is located on 570 square miles of land in southeastern Washington State near the cities of Richland, Pasco, and Kennewick. The mission of Hanford was to produce plutonium. Construction began at the site in 1943, and the first reactor became operational in 1944. During the early years of operation, large amounts of radioactive materials were released from the Hanford facility to the atmosphere and the Columbia River. These included 740,000 curies of iodine-131 into the atmosphere and 22 million curies of mixtures of radionuclides into the Columbia River. Radioactive materials, such as plutonium, have been inhaled or ingested by workers, but the extent of this form of radiation exposures is uncertain. In addition, approximately 30 million cubic feet of high-level, transuranic, low-level, and tank wastes are stored on site. The hazardous wastes stored at the site and the historical releases to the air and water have led to health concerns among communities, tribal nations, and workers.

What have we learned from our studies and assessments of Hanford?

Off-Site Contamination

- The **Hanford Environmental Dose Reconstruction (HEDR) project** evaluated historical off-site radioactive releases from Hanford to the surrounding communities. The study indicated that the largest doses of radiation to residents surrounding the Hanford site were from iodine-131 released to air and deposited on soil and the Columbia River between December 1944 and December 1957. The most important radiation exposure pathway for iodine-131 was the consumption of contaminated milk produced by cows and goats that the residents kept on their properties. Children received the highest estimated thyroid doses. Radiation doses from releases to the Columbia River were highest in the years from 1956 through 1965, peaking in 1960. The most important exposure pathway was the consumption of nonmigratory fish from the Columbia River during the years of releases; this is of particular concern to Native Americans.

- An Agency for Toxic Substances and Disease Registry (ATSDR) **public health assessment** for the Hanford 1100 area (the vehicle maintenance area) concluded that the area did not pose a public health hazard from site-specific contaminants and that follow-up health actions are not indicated at this time.

- An ATSDR health consultation for the **North Slope Area** concluded that data were inadequate to determine that there was no threat to human health if the area were used as a wildlife refuge or if use were unrestricted, which would include agricultural and residential development.

- ATSDR supported an analysis by SENES Oak Ridge, Inc., of dose estimates from consumption of contaminated fish and waterfowl along the **Columbia River** during the period of peak releases. The analysis identified that additional work was needed before doses could be calculated for Native American dietary lifestyles.

Community Health Studies and Activities

- The **Hanford Thyroid Disease Study (HTDS)** evaluated whether or not the occurrence of thyroid disease was related to different levels of estimated radiation dose in a group of 3,441 people who were exposed as children to radioactive iodine (I-131) from the Hanford Nuclear Site during the 1940s and 1950s. This study was conducted by the Fred Hutchinson Cancer Research Center, Seattle, Washington, through funding from the National Center for Environmental Health (NCEH). While thyroid diseases were observed among the HTDS participants, the initial study results did not show a link between the estimated dose to the thyroid from I-131 and the amount of thyroid disease in the study population. Based on the initial study results provided in the draft final report, those who had higher estimated radiation doses appear no more likely to have thyroid diseases than those who had very low doses. These preliminary results do not mean that people living in the Hanford area during the 1940s and 1950s were not exposed to I-131 and other radionuclides, or that these exposures had no effect on the health of people living in the Hanford area. Although no link was found between estimated I-131 radiation dose and the amount of thyroid disease identified by the HTDS in the study population, the study results do not prove that a link between I-131 and thyroid disease does not exist. There may be individuals in the overall population who were exposed to Hanford radiation and did develop thyroid disease because of their exposure.

- ATSDR conducted a study to investigate the association between estimated I-131 exposure and **infant mortality, fetal death, and preterm birth**. The study focuses on the years 1940–1952, and the eight Washington counties included in the HEDR project were Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima. The study used the HEDR project's 1945 exposure estimates for I-131. The study found a 70% higher rate of preterm birth and a 30% higher rate of infant mortality in the areas with the highest estimates of I-131 exposures compared to areas with the lowest estimates of exposure. No association was found for fetal death.

Studies of the Health of Hanford Workers

Workers at Hanford have been included in previous epidemiologic studies. Findings include the following.

- Positive trends in the death rate with occupational exposure to external ionizing radiation have been reported for **liver cancer, cancer of the pancreas, female genital cancer, multiple myeloma, and Hodgkin Disease**.

- **Lung Cancer** has been associated with internal radiation exposure in populations such as uranium miners, but there is less certainty about any relationship with external exposure.

- In a recent multi-site study sponsored by the National Institute for Occupational Safety and Health (NIOSH), an **age at exposure effect** was found. External doses received at older ages, particularly over 45 years, were associated with an increased risk of multiple myeloma.

- A study of the potential association between **paternal exposure** to ionizing radiation at Hanford and **risk of childhood cancer** found no evidence of a link between leukemia and paternal employment at Hanford and weak evidence for a link with central nervous system cancer (CNS).

- Beryllium metal was machined at Hanford and some of the workers exposed to the metal have **chronic beryllium disease**.

What are the current studies and public health activities at Hanford?

Community Involvement

- ATSDR and the Centers for Disease Control and Prevention (CDC) implemented a community involvement activity with the formation of the **Hanford Health Effects Subcommittee** (HHES) in January 1995. The subcommittee provides invaluable advice and guidance to all Hanford-related research and public health activities of the agencies. Composition includes technical experts, clinicians, citizens, public interest groups, tribal representatives, labor representatives, and governmental liaisons (tribes and health departments).

- NCEH, in collaboration with subcommittee members and ATSDR, is evaluating the current health effects subcommittees, including the HHES, to examine how well these community and agency partnerships are working and to identify how to better improve stakeholder involvement through the subcommittee process.

- Through funding from ATSDR, the **Inter-tribal Council on Hanford Health Projects** (ICHHP) also provides important advice and guidance to the agencies from the perspective of the nine Native American tribes within the Hanford region.

- The **Hanford Health Information Network** (HHIN) is a partnership among the State health agencies of Idaho, Oregon, and Washington; nine Columbia Basin Indian tribes and nations; the partners' respective citizen advisory boards (community advisory boards for each State component, as well as for each contractor involved with HHIN, i.e., HHIN's Resource Center; the Hanford Health Information Archives at Gonzaga University, Spokane, Washington; and the Tribal Advisory Board for the Northwest Portland Area Indian Health Board) and the Federal granting authority. HHIN has built a credible risk communication program, focusing on a two-way, interactive exchange of information with individuals and groups about health risks and concerns they may have. HHIN provides information to citizens and education to health care providers about Hanford releases, health risks, and related topics. Information is provided from a variety of perspectives, and the individuals ability to reach their own conclusions is respected. HHIN was funded formerly directly by DOE and currently through ATSDR.

- As a result of the HHIN needs assessments of health care providers at the individual State level, HHIN has presented seminars to health care providers on Hanford health concerns and sponsored conferences on risk communication skills.

Off-Site Contamination

- ATSDR is conducting a combined **public health assessment** (of the 100, 200, and 300 areas) of the Hanford site and is working closely with the HHES to revise the public health assessment document. The agency also performs health consultations on site-specific issues.

- Tribal cooperative agreements funded by ATSDR (not funded in FY 1998, but funded in FY 1999) with each of the nine tribes are being used by the tribes to address human health issues related to exposures from Hanford releases and to build tribal capacity in collaborating with ATSDR on site-specific public health activities, community involvement, and preventive health education.

- NCEH is funding a contract to complete additional work on the **Columbia River dose reconstruction model**. Once completed, Native Americans and other persons whose diets included fish and who utilized the Columbia River between 1956–1965 will benefit from new parameters to estimate radiation doses.

Community Health Studies and Activities

- The purpose of the **Hanford Individual Dose Assessment Project (IDA)** is to provide individual thyroid dose estimates to people who lived or spent time in the HEDR study area and to help them understand what it means to their health. Dose estimates will be provided to people who lived in this study area between December 26, 1944 and December 31, 1957, and who were therefore potentially exposed to air releases of I-131. This project is a service, not a study. It is funded by NCEH through March 2000, and is provided through a joint effort of the State health agencies in Idaho, Oregon, and Washington.

- NCEH is developing **computer programs** to calculate the Evaluation of Radioactive Particles and Short-Lived Radionuclides doses to persons, such as members of the armed services and construction workers whose duty locations and/or living quarters were within the bounds of the reservation. Estimates of doses for persons in off-site locations can also be performed using the code.

- The DOE annually funds the Washington State Department of Health to assess and trend environmental radiation data at Hanford to identify and evaluate potential problems. The Department collects and analyzes environmental radiation samples from the Hanford site and surrounding environs. Through an **independent quality assurance program** the Department assesses the adequacy of the DOE environmental radiation monitoring programs.

- ATSDR is developing an **I-131 exposure subregistry** that will assess a variety of health conditions (other than thyroid disease) in a cohort of 17,000 people exposed as children under age 6 during the period 1945–1951 in a three-county region near the Hanford facility. ATSDR is seeking funding to fully implement the I-131 subregistry which was recommended by ATSDR.

- NCEH is completing additional analyses and will be disseminating findings from the **Hanford Thyroid Disease Study**. A continuation of the study is under development.

Occupational Health Studies

- The University of North Carolina, under a NIOSH grant, is updating a **mortality study of Hanford workers**. The study will reanalyze cancer and noncancer mortality from chronic, low-level external radiation exposure. New methods will be used to estimate doses previously assumed to be zero and to account for the effects of internal dose.

- The United Brotherhood of Carpenters Health and Safety Fund is conducting a **study of heat stress among carpenters** at Hanford, sponsored by a NIOSH grant. The

study will measure physiologic and neurobehavioral changes in workers wearing protective clothing during actual working conditions. Carpenters and other construction workers in remediation and hazardous waste work will benefit from this information.

- Sponsored by a NIOSH grant, the State University of New York at Buffalo is conducting a **mortality study of female nuclear workers** at 12 facilities. This study will be the largest study of mortality among the 80,000 women ever employed in the DOE workforce. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

- DOE through its former worker program is funding two projects at Hanford. The **Hanford Building Trades Medical Screening Program** collects information to determine if workers in the building trades (construction workers) from the DOE Hanford site have health problems due to their employment at that site. The **Medical Surveillance for Former Hanford Production Workers** project will collect information to determine if former production workers and other nonconstruction workers from the DOE Hanford site have health problems due to their employment at that site.

- Two ongoing NIOSH case-control studies combine worker information from multiple sites, including Hanford, to answer study questions about specific cancers. A case-control study is being conducted to clarify the **relationship between lung cancer and external radiation exposure**. The second case-control study is exploring the **relationship between external radiation and leukemia** risk among 250 workers with leukemia compared to similar workers who do not have leukemia.

- The **mortality experience of chemical laboratory workers** from multiple sites, including Hanford in the future, is being studied by NIOSH. Limited previous studies outside the DOE complex suggest an increased risk of cancer in this category of workers.

- Former DOE **construction workers** at Hanford and other sites are being examined in a NIOSH study to further define risk of mortality from exposures to asbestos, beryllium, silica dusts, and other chemical and physical agents regularly encountered by these workers.

- Exposures encountered at Hanford and other sites by **decontamination and decommissioning workers** are being characterized by NIOSH. Working conditions and research needs are being identified at each study site in this Phase I feasibility study. These results are relevant to current workers and support development of surveillance activities.

- The University of Cincinnati, under a NIOSH grant, is creating an **exposure history for the construction trades** at Hanford, based on earlier work at the Oak Ridge site. This project is aimed at improving worker recall of complex occupational exposures across a large number of short-term workplace assignments. New techniques are being used to establish guidelines and formats for personal work histories.

- The University of Washington, under a NIOSH grant, is designing and implementing a **model occupational safety and health surveillance system**. This study is intended to gather appropriate occupational medicine and industrial hygiene data to identify hazardous exposures and adverse health outcomes. An Employee Job Task Analysis process supports the objective evaluation of occupational health interventions through worker involvement in prevention efforts.

What are the gaps in our knowledge and what important issues need to be addressed?

- Need to know impact of the Columbia River pathway on the health of Native Americans and others who may have extensively used the River.

- Need more information on the natural history of thyroid abnormalities.

- Lack knowledge of nonthyroid conditions potentially related to I-131 releases. Direction for future community epidemiological studies may be identified through the I-131 subregistry when it is fully implemented and funded.

- A federally funded medical monitoring program is desired by some Hanford area residents.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- The ATSDR **Hanford Community Outreach Program** will design and provide information and education for eligible persons and clinicians to ensure that appropriate

risk communication and informed decision making occurs. This program will be done in collaboration and parallel with the ongoing proposed I-131 subregistry program.

- ATSDR will develop a **case study in environmental medicine** that will focus on examples of patients presenting with a history of exposure to radiation fallout. The case study will be in a self-training format and continuing medical education credits can be earned through the use of this training material.

- ATSDR will begin a **Columbia River Risk Assessment**, scheduled to start in FY 2000, to be conducted in parallel with the NCEH dose reconstruction activity for the river. A series of workshops will be conducted with experts and community and tribal representatives to evaluate the exposures and potential human health risks.

- Based on the results of previous studies involving Hanford workers, NIOSH has proposed two additional studies that will focus on a single disease. A case-control **study for bone cancer** and a **breast cancer incidence study** would combine worker information from multiple sites, possibly including Hanford, to answer study questions about the relationship of these specific cancers to low-level ionizing radiation.

Public Health Activities Site Plan

Idaho National Engineering and Environmental Laboratory

Idaho Falls, Idaho

Background

The Idaho National Engineering and Environmental Laboratory (INEEL) is on the upper Snake River Plain in the Arco Desert in southeastern Idaho, 4,900 feet above sea level. The site spans Butte, Bingham, Bonneville, Clark, and Jefferson counties in southeastern Idaho and encompasses 890 square miles.

The site was used by the federal government in the 1940s as a gunnery test range. In 1949, the Atomic Energy Commission designated the site as the National Reactor Testing Station. The site's mission was to develop and test nuclear reactors and related facilities. The first nuclear fuel was introduced to the site in 1951, and radioactive waste disposal and storage at the site began in 1954. There are eight major facilities at the INEEL in Scoville, Idaho and offices in Idaho Falls. Major current programs include providing test irradiation services and radioisotope production for medical and commercial uses at the Advanced Test Reactor; processing radioactive wastes into solid form and storing them at the Idaho Nuclear Technology and Engineering Center; conducting light water-reactor safety testing and research; storing, processing, and monitoring radioactive wastes; and conducting environmental restoration. Naval Reactors Program is also located at the Idaho site.

Potential health effects caused by releases of nitric oxides or radioactive fission products to the air from various facilities are important concerns identified by the community and INEEL workers. They are also concerned about the potential for groundwater contamination, increased cancer incidence, and potential beryllium exposure.

What have we learned from our studies and assessments of INEEL?

Off-Site Contamination

- In 1991, the INEEL completed a 3-year effort to **evaluate historical releases** of radioactive materials and potential doses to a hypothetical individual who may have resided at an off-site location with the highest concentration of airborne radionuclides (less significant pathways to off-site radiation doses were not fully evaluated). Airborne releases were highest from 1955 through 1965. The most important radionuclides were iodine-129 and -131, cesium-137, strontium-90, and krypton-88 and other noble gases. The body organs receiving the highest doses were the thyroid

and skin. However, the Evaluation found that "Radiation doses from airborne releases over the operating history of the INEEL were small compared to doses from natural background radiation" and "the largest radiation doses were calculated for an infant in 1956 when the effective dose equivalent from operational and episodic releases was estimated to be 61mrem." Doses to infants were twice as high as doses to adults. The most sensitive population was infants.

- The Idaho Department of Health and Welfare formed the **Dose Evaluation Review and Assessment (DERA) Advisory Panel** to review the 1991 Historical Dose Evaluation and make recommendations for future work. The advisory panel published its findings in 1993 and included the following recommendations for future activities to reconstruct doses from toxic exposures to workers and members of the public potentially affected by INEEL: independent collection and verification of data; comparisons between modeled and monitored data; rigorous uncertainty analyses; quality assurance program for all data collection and analysis; doses should be reconstructed for all exposure pathways; doses should be reconstructed for both radiation and chemical exposure; and future studies should include full public participation.

- NCEH and its contractors located and catalogued several thousand **documents** which they will use to calculate the extent of releases and exposures to the public. This document review was the beginning of the INEEL dose reconstruction project.

Community Health Studies and Activities

- The Idaho Division of Environmental Quality INEEL Oversight Committee maintains **monitoring stations** around INEEL and frequently analyzes air, soil, and water samples around the laboratory.

- In response to community **concerns about a brain cancer cluster**, the Idaho Division of Health (IDH) conducted a Public Health Brain Cancer Study. The study evaluated people in six southeastern Idaho counties (including Moreland, Idaho) who were diagnosed with brain cancer between 1978–1994. IDH found a high rate of brain cancer in the most recent data. However, the cancer cases could not be traced to a common event and therefore could not be associated with a singular cause. IDH staff presented the results of the study to the Idaho Health Effects Subcommittee in December 1997.

- The Idaho Department of Health and Welfare reviewed **cancer morbidity and mortality** data in two additional counties near INEEL, Clark and Minidoka. Clark County lies northeast of INEEL, and Minidoka County is southwest of INEEL. Cancer death rates were examined for the years 1950–1989, and cancer incidence rates were examined for the years 1978–1987 to determine if any significant trends in cancer

morbidity and mortality could be observed in these counties compared with the entire state. No statistically significant differences in age- and sex-adjusted death rates were observed in either county. When cancer incidence data were considered, the overall cancer incidence rate in Clark County was higher than expected based on the state rate for female breast cancer and lip cancer.

- Jablon et al. (JAMA, 1991:1403–1408) examined **cancer mortality** in populations living near nuclear facilities in the United States, including INEEL. Cancer mortality rates in 107 counties near 62 nuclear facilities were compared with cancer mortality rates in control counties that were not near nuclear facilities. Rates were compared for the years 1950–1984. Cancer mortality for Bingham, Butte, and Jefferson counties, where INEEL is located, was compared with nine control counties with similar demographic characteristics in the same region. The authors concluded that no general association was detected between residence in a county with a nuclear facility and death attributable to leukemia or any other form of cancer. The authors noted that interpretation of the study results is limited by the study's ecological approach in which the exposures of individuals are not known.

Studies of the Health of INEEL Workers

- A study of the potential association between paternal exposure to ionizing radiation and risk of **childhood cancer** found no evidence of a link between brain cancer or leukemia and paternal employment at INEEL. Children whose fathers worked at Hanford were more likely to get central nervous system (CNS) cancer than children whose fathers worked at other sites, including INEEL, but this finding was based on small numbers and was not statistically significant.

What are the current studies and public health activities at INEEL?

Community Involvement

- ATSDR and NCEH will continue to work with the **INEEL Health Effects Subcommittee**, which serves as a vehicle for the public and tribal nations to express concerns and provide advice and recommendations on the agencies' public health activities and research at INEEL.

- NCEH, ATSDR, and subcommittee members are evaluating the health effects subcommittees, including the INEEL subcommittee, to determine how well the partnerships between agencies and subcommittees are working and how to improve stakeholder involvement through the subcommittee process.

Off-Site Contamination

- NCEH will complete a **screening analysis of releases** identified by the INEEL Environmental Dose Reconstruction to determine which contaminants and exposure pathways have the highest potential for affecting the public. NCEH will develop site-specific models and parameter values for those contaminants and exposure pathways. Methods and models will include an uncertainty analysis for all calculated results. NCEH contractors, using the documents found in the first phase of its research, will list in order of importance, the chemicals and radionuclides released from the INEEL over the years based on screening calculations for representative persons and exposure scenarios.

- ATSDR continues to work on the **public health assessment** for INEEL including evaluation of past, present, and future exposure pathways. ATSDR also continues to develop **health education programs** for health care providers and the potentially affected community.

Community Health Studies and Activities

- NCEH will continue to work with the Cancer Data Registry of Idaho on the **analysis of the spatial/temporal distribution of cancers** in the vicinity of the INEEL

Occupational Health Studies

- The **mortality experience of INEEL workers** has not been previously studied. NIOSH is conducting a mortality study of over 70,000 INEEL workers. Worker exposures to external ionizing radiation and a variety of chemicals are being evaluated. This cohort is being included in the International Agency for Research on Cancer (IARC) multi-country study.

- Boston University, in a cooperative agreement with NIOSH, is evaluating the effects of **job stressors including downsizing and reorganization** in a multisite study. Organizational climate, worker health, and performance at four DOE sites will be assessed.

- Exposures encountered at INEEL and other sites by **decontamination and decommissioning workers** are being characterized by NIOSH. Working conditions and research needs are being identified in this Phase I feasibility study. These results are relevant to current workers, and support development of surveillance activities.

- As part of a multi-site case-control study, NIOSH is combining worker information from multiple sites including the INEEL to answer questions about the relationship between **lung cancer** and external radiation exposure.

- A DOE-funded study, **Medical Surveillance for Former Idaho Falls, Idaho, Workers**, will attempt to determine whether former hourly and salaried workers from the Idaho National Engineering and Environmental Laboratory might eventually have health problems due to employment at that site. The project is being carried out by a group of investigators from the Paper, Allied-Industrial, Chemical and Energy Workers International Union; the University of Massachusetts at Lowell; and Queens College, City University of New York. Phase I of this project includes collection and evaluation of existing information from the site; completion of a mail questionnaire survey of a large sample of former nuclear workers from the site; holding focus group and risk-mapping sessions for former workers; and preparing a list of health care providers and community resources in the area near the site. During Phase II of the project, the investigators will begin to decide which workers might possibly be at significant risk for health problems related to their exposure, and those workers will be offered an opportunity to participate in a free medical screening program.

What are the gaps in our knowledge and what are the important issues which need to be addressed?

- Depending on the results of the environmental dose reconstruction, a determination may need to be made of the potential health risks that might result from past exposures to chemicals and radionuclides released from the site to the communities surrounding INEEL.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- NIOSH will **evaluate the need for follow-up studies** of INEEL workers based on the results of the ongoing mortality study.

Public Health Activities Site Plan

Laboratory for Energy-Related Health Research

Davis, California

Background

The Laboratory for Energy-Related Health Research (LEHR) was a Department of Energy (DOE) research facility, located on the property of the University of California at Davis (UCD), in Solano County, in the city limits of Davis, California. DOE and its predecessor, the Atomic Energy Commission, funded the laboratory primarily to investigate the long-term effects of low levels of radium-226 (Ra-226) and strontium-90 (Sr-90) in beagles. The LEHR site occupied approximately 15 acres adjacent to existing UCD landfills, and a portion of the dog pen area was built over a part of the landfills. The main UCD campus lies north of the site, and the property west, south, and east of the site is used for farming. The south fork of Putah Creek flows east approximately 250 feet from the southern boundary of the site. Today, UCD operates the Institute of Toxicology and Environmental Health at the site where they formerly operated the Laboratory for Energy-Related Health Research.

Animal wastes generated during LEHR activities were placed in holding tanks, trenches, boreholes, and the UCD landfills near the LEHR animal pens and laboratories. Restoration of the site, including the removal of some buildings, cages, and the contents of waste tanks, began in 1990. Generally, DOE is responsible for cleanup of site soils and UCD is responsible for cleanup of groundwater.

What have we learned from our studies and assessments of LEHR?

Off-Site Contamination

- In a site summary document, the Agency for Toxic Substances and Disease Registry (ATSDR) identified **three areas of public health concern**: nitrate in the groundwater, organic chemicals in groundwater, and potentially contaminated fish in Putah Creek.

- Putah Creek fish were collected and tested for potential mercury and lead contamination. ATSDR concluded that elevated levels of **mercury in large-mouth bass** are a public health hazard to fetuses and nursing infants whose mothers eat large-mouth bass from the creek.

Community Health Studies and Activities

- There have been no studies of the health of residents living near the laboratory.

Studies of the Health of LEHR Workers

- There have been no studies of the health of LEHR workers.

What are the current studies and public health activities at LEHR?

Community Involvement

- ATSDR is working with the Davis South Campus Superfund Oversight Committee to identify and address **community health concerns**.

Off-Site Contamination

- ATSDR is conducting a **public health assessment** of the LEHR site. The public health assessment assesses the public health impact of off-site releases of hazardous and radioactive materials. The findings of the health consultations will be incorporated into a public health assessment document that will address all exposure pathways for the site. The public health assessment will address the site's impact on Putah Creek water quality and health implications on the residents who use the Putah Creek fish as a food source and the creek for recreation. The public health assessment will also address community concerns, including, mercury contamination, and bioaccumulation of chlorinated hydrocarbons, pesticides, dioxins, and chlorinated biphenyls (PCBs).

- Yolo County is currently sponsoring a Putah and Cache Creek Ecotoxicity Project which is being conducted by the Central Valley Regional Water Quality Control Board.

Community Health Studies and Activities

- The California Department of Health Services (CDHS), Environmental Health Investigations Branch, through a cooperative agreement, prepared a health consultation and a fact sheet on **nitrate in drinking water** to assist ATSDR in addressing the nitrate concern. CDHS distributed their health consultation and fact sheet in the community surrounding the LEHR site and in other areas of the state.

Occupational Health Studies

- There are no occupational health studies currently at the LEHR site.

What are the gaps in our knowledge and what important issues need to be addressed?

As the public health assessment for the LEHR site continues, specific data gaps will be identified. The agencies will develop proposed activities to address these data gaps.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway which were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- ATSDR will determine its **community involvement and health education** activities based on the findings and recommendations from the draft public health assessment and comments received from community residents during the public comment release period. These activities could include (1) holding a public availability session for residents impacted by the LEHR and (2) developing community health educational materials which may include fact sheets, educational brochures, and document summaries.

Public Health Activities Site Plan

Lawrence Livermore National Laboratory

Livermore, California

Background

The Lawrence Livermore National Laboratory (LLNL) site consists of two separate parcels: the main site and site 300. The LLNL main site is located on the eastern edge of the city of Livermore, approximately 40 miles east of San Francisco, California. The main site occupies 826 acres in the flat land of the Livermore-Amador Valley in Alameda County. Site 300 is approximately 15 miles east of the main site and occupies approximately 7,000 acres in Alameda and San Joaquin counties. The terrain consists of rolling hills and canyons at elevations ranging from 525 to 1,750 feet above sea level.

In 1942, the future LLNL site was converted from agricultural use into a naval flight training base and aircraft assembly and repair facility. Since 1951, the site has been an active, multi-program research facility that is operated by the University of California for the Department of Energy (DOE). The laboratory's mission is research and education in defense, biomedicine, energy, magnetic fusion, lasers, and the environment. A number of operations at LLNL handle or generate hazardous materials, radioactive wastes, and mixed wastes. Activities from naval operations prior to 1951 and activities from LLNL since that time have resulted in on-site and off-site contamination and potential exposure to both workers and the residents of Livermore. Local residents are particularly concerned about radiological contamination in parks and other public areas in and around Livermore. Additional community concerns include (1) the contamination of municipal and residential water supplies; (2) air releases of tritium, depleted uranium, and beryllium during nonnuclear testing of weapons systems at site 300; (3) air releases of radioactive and hazardous materials from the main site, especially tritium; (4) water contamination by tritium at site 300; (5) plutonium-239 in municipal sewage sludge that later distributed to municipal and private users as a soil amendment; (6) radiological measurements in sewage effluent and sludge from Pleasanton's Sunol Avenue sewage treatment plant; and (7) the health impacts, including cancer, non-cancer diseases, and developmental disabilities.

What have we learned from our studies and assessments of LLNL?

Off-Site Contamination

- In September 1984, the California Department of Health Services (CDHS) issued an Order for Compliance to LLNL to provide alternative water supplies to residents west

of the facility whose wells had been contaminated by hazardous substances from the site. The order also directed LLNL to conduct a groundwater investigation.

- In November 1985, the California Regional Water Quality Control Board (CRWQCB) issued an order directing LLNL to investigate and clean up the on- and off-site groundwater contamination. In response, LLNL began investigating the source and the vertical and lateral extent of the contamination of soil and groundwater.

- In 1986, a plume of groundwater contaminated with volatile organic compounds, including tetrachloroethylene, was found to have migrated 3,600 feet west of the main site. Sampling of water from monitoring wells at the main site found contamination by tetrachloroethylene, trans-1,2-dichloroethylene, and trichloroethylene. Soil on the site was also found to be contaminated.

- The California Department of Health Services (CDHS), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared a health consultation which concluded that public water supplies near the LLNL main site have not been impacted by groundwater contamination from the site. CDHS also identified private water wells that may be impacted by groundwater contamination from the LLNL main site and recommended that ATSDR evaluate them further. Subsequent investigation conducted by CDHS determined that all potentially impacted private off-site water wells have been sealed and abandoned by LLNL following State of California rules and regulations. Therefore, there is no threat to human health from these former water-supply wells.

Community Health Studies and Activities

- In a 1995 health study, CDHS, with assistance from the Centers for Disease Control and Prevention (CDC), investigated the 1960–1991 **cancer incidence for children and young adults** who lived in Livermore. CDHS reported an elevated rate of melanoma for children and young adults when compared to rates in Alameda County. No increased risk of leukemia or non-Hodgkin lymphoma was found.

- A **cancer incidence review** was conducted in 1996. In response to community concerns about elevated cancer rates in the Livermore area, CDHS, with assistance from CDC, assessed the 1988–1993 incidence of invasive cancer in residents of eight census tracts that include Livermore and the surrounding area. The incidence of cancer was not found to be elevated among residents of the eight tracts, as compared to the rates of Bay Area residents. The incidence of melanoma was elevated in one tract located west of the LLNL main site, although the elevation was not statistically significant.

- In March 1999, the **California Birth Defects Monitoring Program** (CBDMP) looked at birth defects in two zip codes (94550 and 94551) around Livermore for the years 1983–1989, the only years that CBDMP operated in Alameda County. CBDMP found no evidence that there was increased rate of birth defects among people living around Livermore.

Studies of the Health of LLNL Workers

- In 1980 and 1982, the California Department of Health Services determined that the incidence of malignant melanoma was higher for LLNL employees than for the population of the region. For the 19 cases diagnosed from 1972–77, work involving exposure to ionizing radiation was not associated with a diagnosis of melanoma; working as a chemist was. In 1984, based on a review of records for persons with and without melanoma, occupational factors were reaffirmed as being associated with melanoma risk. Later, when the incidence rates for LLNL workers were calculated for the longer time period of 1969–80, higher rates were found for cancers, in addition to malignant melanoma. The incidence rates for salivary gland cancer and rectal cancer, among female Laboratory workers, were above the rates for the region. For male laboratory workers, other nervous system tumors, excluding brain tumors, were higher than expected.

- Thirty-one laboratory workers with malignant melanoma and a control group were interviewed about personal and occupational factors that might be associated with the disease. Five factors were more common than expected among persons with malignant melanoma. They were exposure to radioactive materials, work at Site 300, exposure to volatile photographic chemicals, participant at the Pacific Test Site, and chemist duties. The most recent interview study of 69 cases and an equal number of controls found that differences in personal factors, genetics, and recreational use of the outdoors were consistent with what is known about malignant melanoma of the skin. Only occupational exposure to alcohols, out of 39 industrial exposures examined, was more common among persons with melanoma.

- Studies of the microscopic features of the melanoma tumors indicated that the tumor thickness for laboratory workers was significantly less than for individuals that did not work at LLNL, up to the time when the concern became public in 1977. These data were taken as evidence of earlier detection of tumors at LLNL. A greater proportion of workers hired before 1962, who were engineers, particularly electrical engineers, had dark moles or pigmented nevi that are associated with a high risk of malignant melanoma.

What are the current studies and public health activities at LLNL?

Community Involvement

- ATSDR, with assistance from CDHS, established a **site team** to identify issues and set priorities in the ATSDR public health assessment process. The site team includes representatives from the community, local and national interest groups, and local, state, and federal government agencies. ATSDR conducts regular meetings of the site team and provides written updates in the intervals between the team's meetings. Meetings are held in the evening and are open to the public, and some site team meetings have had as many as 100 persons in attendance.

- Through its site team meetings, ATSDR provides information on exposure and health issues of interest to team members, including basic information about radiation exposures and health effects. ATSDR also provides public health statements on plutonium, uranium, and trichloroethylene.

Off-Site Contamination

- ATSDR is conducting a **public health assessment** of the LLNL site. The public health assessment assesses the public health impact of off-site releases of hazardous and radioactive materials. Pathways of concern are initially being addressed as a series of health consultations. The findings of the health consultations will be incorporated into a public health assessment document that will address all exposure pathways for the site.

- CDHS, under a cooperative agreement with ATSDR, prepared a health consultation addressing plutonium in **Big Trees Park** in Livermore in 1998. The consultation has been released for public comment and is currently undergoing final review. Plutonium (Pu -239) in surface soils in the park was determined to be at levels that do not pose a public health hazard. The consultation identified possible pathways for contamination of the park, including aerial dispersion, sediment distribution from an adjacent creek channel, and use of contaminated sewage sludge as fill material. As a result of the issues raised in this health consultation, DOE conducted additional soil sampling for plutonium in Big Trees Park. ATSDR is evaluating these data to determine (1) the health impacts to residents of Livermore who use the park, (2) the distribution of plutonium within the park, and (3) the pathways by which contamination may have reached the park. ATSDR is incorporating the findings into an addendum to the 1998 health consultation.

- ATSDR is conducting a health consultation to characterize the nature and extent of the off-site **contamination of groundwater** near the LLNL main site and to

determine whether private wells in the site area are now or have been impacted by groundwater contamination from the site.

Community Health Studies and Activities

- There are currently no ongoing community health studies.

Occupational Health Studies

- There are no occupational health studies being conducted at this time.

What are the gaps in our knowledge and what important issues need to be addressed?

As the public health assessment for the LLNL sites continues, specific data gaps will be identified. The agencies will develop proposed activities to address these data gaps.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- NIOSH has proposed an additional study of brain cancer, possibly including LLNL, to answer study questions about the relationship of these specific cancers to low-level ionizing radiation. Although this study will be conducted after FY2000, preliminary activities will be conducted during FY2000.

- ATSDR, in consultation with community organizations and appropriate state agencies, will assess health **education needs for the community and health-care professionals**. On the basis of this needs assessment, ATSDR will develop a program to regularly provide information and training that will enable health-care providers to (1) take an exposure history and (2) promote behavioral changes that will be health-protective. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community.

Public Health Activities Site Plan

Los Alamos National Laboratory

Los Alamos, New Mexico

Background

The Los Alamos National Laboratory (LANL) comprises about 43 square miles (27,500 acres) in Los Alamos and Santa Fe counties, New Mexico. It is situated on a volcanic plateau that is composed of a number of mesas separated by steeply sloped and deeply eroded drainage canyons oriented from west to east. The town of Los Alamos had a population of less than 19,000 people in 1990. Albuquerque (60 miles south) and Santa Fe (25 miles southeast) are the closest metropolitan areas. Several Native American pueblos are adjacent to the laboratory. The climate is semiarid, with annual precipitation of about 18 inches.

Public health issues of concern include the potential health effects in the neighboring populations from current and past releases of radioactive and hazardous materials. The major source of current radiological atmospheric releases is the Los Alamos Neutron Science Center, formerly known as the Los Alamos Meson Physics Facility, which accounts for 95% of current air releases, primarily of radioactive gasses. Other air releases come from incinerators which had been used from 1951 to the early 1990s to recover plutonium, the Omega Reactor which was defueled in 1993, the Chemical and Metallurgical Research Building (TA-3), the HP Site (TA-33), and the former DP site (TA-21). Possible sources of contamination of the groundwater are the active waste disposal area (TA-54-Area G); firing sites in Bayo Canyon (used during 1944–1962 and beyond), which included underground testing and radioactive lanthanum (RaLa) implosion tests releasing lanthanum-140, strontium-90, and depleted uranium; atmospheric tracking tests conducted in 1950 which released lanthanum-140; and outfall pipes discharging laboratory wastes and other liquid wastes directly to Acid and Pueblo canyons. Mortandad Canyon received direct discharges of both hazardous and radioactive liquid wastes.

What have we learned from our studies and assessments of LANL?

Off-Site Contamination

- An Agency for Toxic Substances and Disease Registry (ATSDR) exposure investigation that conducted sampling on **San Ildefonso** lands, adjacent to the laboratory, found elevated levels of plutonium in surface water and elevated concentrations of plutonium-239 and cesium-137 in sediment. Although these levels were higher than background levels, they are not at levels known to adversely affect public health.

- An ATSDR health consultation determined that levels of plutonium in **Acid Canyon** were not a public health hazard for recreational users of Acid Canyon.

- Although **tritium was detected in groundwater wells**, including monitoring wells, residential wells, and Los Alamos water supply wells, an ATSDR health consultation determined that the water in the wells was safe for drinking.

- An ATSDR health consultation on **nitrates in groundwater** recommended eliminating potential exposure to nitrates for the most sensitive population: infants less than 4 months of age.

Community Health Studies and Activities

- In response to community concerns over a perceived excess of brain tumors and their relationship to radiologic contaminants from LANL, the New Mexico Department of Health, with funding from DOE, conducted a review of cancer rates in Los Alamos County. In 1993, the health study determined that incidence of brain cancer was not elevated. However, the study determined that incidence of thyroid cancer was elevated beginning about 1980, showed an excess incidence from 1988–1993, and began declining thereafter. No single factor about the people with thyroid cancer or local medical practices could explain the higher rates.

  Further analyses of incidence and mortality data, and tumor characteristics were conducted for eight specific cancers sites or types. Rates generated for Los Alamos County and its census districts were based on a very small number of cases. Therefore, it could not be determined if these unstable rates reflected random variation or true trends in underlying cancer risk.

- In FY 1997, ATSDR conducted a **needs assessment** for a number of communities in the Los Alamos area. Based on the findings of the needs assessment, ATSDR, the National Center for Environmental Health (NCEH), and the National Institute for Occupational Safety and Health (NIOSH) have developed plans for conducting community involvement and health education activities.

- ATSDR sponsored a **workshop** for pueblo and rural communities in September 1995. Approximately 60 people attended the workshop and received environmental health information on chemical and radiation exposure.

Studies of the Health of LANL Workers

- The cause-specific mortality rates for all 15,727 LANL white male employees was similar to the rates for the US general population through 1990. Positive trends in the

mortality rate with increasing external radiation dose were reported for cancers of the brain and central nervous system, esophagus, and Hodgkin Disease. There was an association between increasing doses of external radiation and kidney cancer, as well as lymphocytic leukemia among workers who were not exposed to plutonium. However, the mortality rates were not elevated according to statistical tests.

- There were 5,424 Zia Company employees monitored for exposure to either plutonium or external ionizing radiation. Mortality was studied up to the end of 1984. Hispanic males had high mortality rates for stomach cancer, all injuries, all accidents, and motor vehicle accidents. Non-Hispanic males had high mortality rates from all causes, all cancers, lung cancer, all circulatory diseases, and all respiratory diseases.

- A cohort of 224 employees at LANL and Zia Company, with a 10 nCi or greater internal deposition of plutonium, was studied up to the end of 1980. Their mortality experience was compared to the U.S. general population and to a group of workers not exposed to radiation. No cause of death was reported as higher than the comparison groups.

- The mortality experience of 6,970 females employed at LANL was studied up to the end of 1981. The death rate for suicide was higher among women monitored for radiation exposure than the comparable U.S. general population rate. This finding was not related to duration of employment or plutonium exposure.

- A reported excess number of cases of skin cancer (malignant melanoma) among Lawrence Livermore National Laboratory employees motivated scientists to conduct a similar investigation among LANL employees. No excess skin cancer was detected among the 11,000 workers studied between 1969 and 1978. An in-depth study of 15 LANL employees with skin cancer found no link between the cancer and exposure to external radiation.

- A multisite study of multiple myeloma (a blood cell cancer) reported that the myeloma death rate at LANL was not different than the U.S. general population rate. However, external radiation exposures received at age 45 years or older were associated with a higher risk of dying from myeloma.

What are the current studies and public health activities at LANL?

Community Involvement

- ATSDR, NCEH, and NIOSH will continue to work with **community-based organizations**, such as the Northern Pueblos Institute, the New Mexico Educational Opportunity Center, the Tribal Environmental Watch Alliance, the Rio Arriba

Environmental Health Partnership, the Eight Northern Indian Pueblos Council, and the Los Alamos Citizens' Advisory Board, to address current progress and future plans.

Off-Site Contamination

- NCEH has initiated a **historical documents retrieval and assessment project** at LANL. The project began in FY 1999 and is expected to continue for at least three years. This project will locate, copy, and evaluate documents that contain information about historical chemical or radionuclide releases from LANL to the environment. NCEH will work with Los Alamos stakeholders to determine if the information warrants an off-site exposure assessment.

Community Health Studies and Activities

- NCEH awarded a 3-year grant to the Rio Arriba Environmental Health Partnership at the University of New Mexico to conduct **community education and training** related to environmental health research near LANL.

Occupational Health Studies

- An ongoing NIOSH **leukemia case-control study** will combine worker information from several DOE sites, including LANL. This study, the largest of its kind, will examine the relationship between external radiation and leukemia risk among 250 workers with leukemia compared with workers who do not have leukemia.

- Sponsored by a NIOSH grant, Boston University is evaluating the effects of **job stressors, such as, downsizing and reorganization** in a multi-site study, including LANL . Organizational climate, worker health, and performance at four DOE sites will also be assessed.

- The State University of New York is conducting a **mortality study of female nuclear workers** at 12 facilities, including LANL. This study, sponsored by a NIOSH grant, will be the largest mortality study conducted among the 80,000 women ever employed in the DOE work force. Risk estimates for exposure to ionizing radiation and chemical hazards will be calculated.

- The University of Southern California is developing an integrated approach to statistical **exposure assessment models of complex mixed exposures to chemical and biochemical agents**. Based on task-specific exposure measurements, this NIOSH-sponsored project is attempting to identify and develop appropriate statistical tools for the modeling of single- and mixed-agent exposures and resulting internal doses. The resulting system is intended for use in providing risk-based assessment of

possible adverse health outcome incidence to guide interventions and medical surveillance.

- Phase I of the **DOE Former Worker Medical Surveillance Project at LANL** reviewed information that will be used to determine if former laboratory workers have health problems related to their employment at the laboratory. The focus is on two groups of former workers: machinists and workers exposed to beryllium. This project is being carried out by a investigators from Johns Hopkins University; the Laborers' Health and Safety Fund of North America; the Environment, Safety, and Health Division of Los Alamos National Laboratory; and the National Jewish Medical and Research Center.

  Phase I of this project includes these major tasks: reviewing the site history to determine if there were potentially hazardous exposures; locating existing sources of health data related to former workers; and developing a method for contacting former workers from the site. During Phase II of the project, the investigators will determine which workers have health problems most probably related to their exposure. Those workers will be offered an opportunity to participate in a free medical screening program.

- **DOE Beryllium Workers Medical Surveillance Program** (1) identifies and locates workers exposed to beryllium; (2) provides enhanced medical monitoring for early identification of chronic beryllium disease (CBD); and (3) characterizes employees' occupational exposures to beryllium during current and past operations. The program is currently operating at the Oak Ridge Y-12 Plant, the Rocky Flats Environmental Technology site, and LANL. More than 20,000 current and former workers have been contacted to date. About 7,000 have responded. More than 100 cases of chronic beryllium disease have been detected complex wide. At the same time, the Los Alamos Beryllium Worker Health Surveillance Program is evaluating the validity and positive predictive value of a new blood test (the flow cytometry-based lymphocyte proliferation test) in screening for CBD.

What are the gaps in our knowledge and what important issues need to be addressed?

- The increased rates of cases of thyroid and other cancers seen during the 1980s and the subsequent decrease in those rates remains unexplained.

- Concerns about benign thyroid condition in communities at large, and specifically among residents of the pueblos.

- Review of soil exposure pathways.

- Investigation of apparent cluster (four confirmed cases) of leiomyosarcoma in Los Alamos.

- Concern about air pathways associated with the incinerator, including historical concentrations of dioxin.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- In 1991, ATSDR was petitioned by former Congressman Richardson to conduct a **public health assessment**. The public health assessment will assess the potential public health impact for off-site releases of hazardous materials. To avoid any duplication of effort, ATSDR will use the data and information collected by NCEH during their dose reconstruction activity. Public health assessment activities can include current exposure assessments made by direct sampling (for example, the San Ildefonso sampling). The public health assessment process can also provide current sampling to validate dose reconstruction models as was done at the Fernald site. ATSDR will provide health consultations to DOE and the community as requested. These consultations will evaluate and address specific questions regarding site remediation or community concerns.

- The NIOSH study of **Zia workers** will examine the mortality experience of Hispanic workers at a DOE site. In a previous study at the site, there were differences in the causes of death between Hispanic and non-Hispanic males. This study will update the mortality status of the workers at Zia through 1997 and will further explore race and gender-specific differences in causes of mortality

- In FY 2000, ATSDR will coordinate **health education activities** through two cooperative agreements with the Association of Occupational and Environmental Clinics (AOEC) and the National Coalition of Hispanic Health and Human Services Organizations (COSSMHO). These activities will include health care provider education as well as community health education. Other local stakeholders will be involved in the planning process.

Public Health Activities Site Plan

Middlesex Sampling Plant

Middlesex, New Jersey

Background

The Middlesex Sampling Plant (MSP) is located in the Borough of Middlesex, New Jersey. The plant is in the Raritan River drainage basin, and runoff from the site flows south into the Raritan River through a series of ditches, streams, and brooks. The Middlesex plant was established in 1943 as part of the Manhattan Engineer District for the sampling, storing, and shipping of radioactive ores. In 1967, all Department of Energy (DOE) activities at MSP were terminated. From 1969 to1979, the site served as a training center for Marine Corps reserve units. In 1980, the site became part of the DOE Formerly Utilized Sites Remedial Action Program (FUSRAP).

Over the years that the plant was operating, the buildings and soil of the MSP property and the soil of other properties in the vicinity were contaminated with elevated levels of radioactive hazardous substances. A significant portion of the plant property is covered by contaminated soil that extends to depths of nearly five feet. During regrading of the site in 1948, some of this contaminated soil was sent to the Middlesex Municipal Landfill and to two other properties nearby.

Excavation of radioactive material from the Middlesex Municipal Landfill was completed in 1986. The excavated landfill material was stored at MSP until 1998, when it was shipped to an off-site hazardous waste landfill.

The two contaminated properties in the vicinity and a drainage ditch to the south of the site were remediated in 1981. Soil and material removed from these properties are stored at MSP. The material is scheduled for off-site disposal in 1999.

What have we learned from our studies and assessments of Middlesex?

Off-Site Contamination

- The presence of radioactive hazardous substances in **surface water samples** collected downstream of the site indicate contamination of the wetlands.

Community Health Studies and Activities

- There are no community health studies or activities related to the MSP site.

Studies of the Health of Middlesex Workers

- Currently, there are no studies being conducted on the health of MSP workers.

What are the current studies and public health activities at Middlesex?

- A **public health assessment** for the Middlesex Sampling Plant site began in FY 1999. ATSDR will determine its **community involvement and health education** activities based on the findings and recommendations from the draft public health assessment and from the comments received from community residents during the public comment release period. These activities could include (1) holding a public availability session for residents potentially impacted by MSP and (2) developing community health educational materials which may include fact sheets, educational brochures, and document summaries.

What are the gaps in our knowledge and what important issues need to be addressed?

Awaiting results of the public health assessment.

Proposed Activities

New Activities for FY 2000

- There are no new activities planned for FY 2000. ATSDR proposes to continue the projects already underway which were listed previously.

Public Health Activities Site Plan

Monticello Mill Tailings Site and Monticello Vicinity Properties Site

Monticello, Utah

Background

The Monticello Mill Tailings Site, an abandoned uranium processing mill, was the source of contamination in soils and buildings throughout the city of Monticello, Utah. Initially, the site served as an ore-buying station. Ore production increased sufficiently to justify mill construction in 1941. The mill produced vanadium (1942–1943), uranium-vanadium sludge (1943–1946), and uranium (1949–1960).

Contaminated soils were taken from the mill site and used as fill for open lands; backfill around water, sewer, and electrical lines; and sand mix in concrete, plaster, and mortar. As a result, residents have been exposed to low levels of uranium, radium -226, radon -222, and associated radiation. A total of 449 properties are being remediated. The total tonnage of uranium mill tailings removed from the mill site for construction purposes was never documented. However, contaminated material from the vicinity properties is estimated at 156,000 cubic yards.

What have we learned from our studies and assessments about Monticello?

Off-Site Contamination

- Hazardous substances include yellow cake (uranium oxides), black cake (vanadium oxides), and uranium. The tailings that remain on the mill site would be considered a public health hazard today if the public had access to the mill site. However, access is strictly controlled. The mill site, therefore, currently does not pose a direct threat to area residents.

Community Health Studies and Activities

- The Utah Cancer Registry is part of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program. Utah has the lowest cancer incidence in the SEER system and the lowest overall cancer mortality rate of any state. The main reason seems to be the low smoking rates and the associated low rates of smoking-related cancers. Since becoming part of the SEER system, Utah has had an incidence rate approximately 16% below national rates, while mortality rates are approximately 28% below the national average.

- As part of the public health assessment published in 1997, the Agency for Toxic Substances and Disease Registry (ATSDR) reviewed available health outcome data and identified the following increased causes of death for San Juan County compared to other Utah counties: (1) renal failure in women only, (2) breast cancer in women, and (3) cancer associated with the respiratory tract.

Studies of the Health of Monticello Workers

- Industrial hygiene surveys performed when the mill was operating reported that conditions were dusty at the mill and workers were exposed to levels of radioactive dusts above allowable concentrations (Holaday et al. 1952; Archer et al. 1973). Because of the known exposure to workers, a urine sampling and assaying program was begun at the mill in 1956 which would have detected uranium exposure. Workers in areas with higher air dust levels, all males, were sampled weekly.

- In occupational cohort studies of uranium mill workers, excess deaths due to nonmalignant respiratory disease and cancer of the blood-forming organs other than leukemia have been reported (Archer et al., 1973; Waxweiler RJ et al., 1983).

- A more recent survey of health conditions among American Indian and non-Indian former uranium mill and mine workers reported that a majority of these workers reported respiratory diseases or symptoms which included chronic obstructive pulmonary disease, emphysema, fibrosis, persistent cough, pneumoconiosis, and silicosis**.**

What are the current studies and public health activities at Monticello?

Community Involvement

- ATSDR is developing a community involvement program. The goal of the program is to establish a working group to help guide decisions on ongoing investigations, future surveillance, further health studies, or other health activities. Potential members include community representatives, staff members from ATSDR and other federal agencies, and state and local representatives from the environmental health or public health community.

Off-Site Contamination

- DOE is continuing remediation of the Monticello vicinity properties.

Community Health Studies and Activities

- As a follow-up to the 1997 public health assessment, ATSDR undertook a health consultation with the following objectives (1) update data on leukemia, lymphoma, breast, kidney, and respiratory cancer incidence from 1943–1996 and analyze the 1967–1996 data, (2) update data on death due to renal failure from 1993 through 1995 and analyze the 1979–1995 data, and (3) collect and analyze incidence data on end-stage renal disease (ESRD) from 1977 through 1995. This will be peer reviewed and published before the end of 2000.

Occupational Health Studies

- The National Institute of Occupational Safety and Health (NIOSH) is conducting a follow-up study of former uranium mill workers, although Monticello is not included because employment records could not be located. The study will focus on the Four Corners area (the point of intersection for Arizona, Colorado, New Mexico, and Utah) and will attempt to identify 500 exposed workers and 100 controls in order to conduct a cross-sectional medical survey. The outcomes of interest are pulmonary and renal effects. The University of New Mexico Medical Center will send a mobile van out to communities in this area to carry out the medical component of this study.

What are the gaps in our knowledge and what important issues need to be addressed?

- The gaps specific to Monticello are being addressed in the ongoing studies.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- ATSDR will work with the Monticello communities to complete a health education needs assessment and implement educational activities to assist the communities in understanding the effects of exposure to low doses of radiation associated with the Monticello site.

- Based on results from the health consultation drafted in 1999, ATSDR will continue to update and re-analyze cancer incidence, renal failure and ESRD data. More over, knowing the high proportion of American Indians in Monticello and in San Juan County, adequate comparisons are being planned for the future with non-exposed populations sharing similar ethnic and tribal background and thus similar susceptibility to the development of kidney disease.

Public Health Activities Site Plan

Mound Plant

Miamisburg, Ohio

Background

The Mound Plant is a Department of Energy (DOE) production facility located in Montgomery County, Ohio, within the city limits of Miamisburg. While the research and production areas of the site once occupied 306 acres, most of Mound's DOE activities have been terminated or relocated to other DOE facilities, and parcels of the original property are being turned over to private ownership as they become available. Miamisburg, a community of 18,000 people, is 10 miles southwest of Dayton. A Consolidated Rail Corporation (Conrail) freight line is along the western border of the plant. The Miamisburg Community Park and an abandoned part of the old Miami-Erie Canal are farther west of the Conrail tracks. The Miami River is approximately a half mile from the Mound Plant.

Mound was built in the late 1940s under the auspices of the war department. Until recently, the mission of the Mound Plant included research and development and the manufacture of components for nuclear weapons. Scientists at the plant conducted many research and development projects, including a program conducted from the midfifties until 1985 to study radioactive isotopes, such as those of uranium and thorium. DOE either ended these programs or transferred them to other facilities. The one remaining active production program at the site is the manufacture of electric power sources. These power sources, which utilize plutonium-238, are used in satellites and spacecraft. Much of DOE's work at the Mound Plant is related to environmental cleanup of the site.

Public health issues at the Mound Plant include past exposures to both workers and residents in the community to a wide range of radioactive and chemical contaminants including polonium-210, plutonium-238, and tritium. Current exposures are to workers involved in the cleanup of the site.

What have we learned from our studies and assessments of Mound?

Off-Site Contamination

- The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a **public health assessment** of possible off-site exposures to hazardous materials released from the Mound Plant and determined that the plant currently poses no apparent public health hazard. Insufficient information, however, made it impossible for ATSDR to

determine whether releases of polonium or nonradioactive materials from the site during the 1950s ever posed a public health hazard.

- After being notified by ATSDR as part of the public health assessment process that levels of plutonium-238 were elevated in the Miami-Erie Canal and the **Miamisburg Community Park**, the city of Miamisburg closed the fishing pond as a public health precaution.

Community Health Studies and Activities

- An **environmental health workshop** was developed through a cooperative agreement with the Boston University School of Public Health to educate and assist communities and health care providers near DOE sites in evaluating the usefulness and practicality of collecting and assessing health outcome data. A workshop for the community surrounding the Mound Plant was presented in Miamisburg, Ohio, on May 19, 1995. ATSDR does not currently anticipate a need for further health education activities in the community around the Mound Plant unless new information becomes available.

Studies of the Health of Mound Workers

- A **preliminary study** examined the mortality of 4,697 white male Mound Facility employees through 1979. Overall, no death rate was higher than expected based on U.S. general population rates. Among men first hired between 1943 and 1945, the rates for all causes of death combined, all cancers combined, cancers of the rectum and lung , all respiratory diseases, and all injuries were higher than expected. The higher rates for all causes of death combined and lung cancer were localized among men who worked less than 2 years. Among men hired through 1959, cancer of the prostate was high among those who worked more than 5 years.

- A **second mortality study** looked at the same Mound worker group. No increase in overall mortality or site-specific cancers was noted. In a subgroup of 3,229 workers monitored for external radiation, a dose-response relationship based on small numbers of deaths was observed for lymphopoietic/hematopoietic cancers and for all leukemias.

- Subsequently, the mortality of 4,402 white male employees at the Mound Facility was studied through 1983. Among the **men initially hired during WWII**, increased mortality rates, relative to the U.S. general population, were reported for: all causes of death combined, all cancers combined, cancer of the rectum, lung cancer, chronic rheumatic heart disease, all respiratory diseases combined, and all injuries. These results are fairly similar to the earlier study. Among the 2,181 employees monitored for Polonium-210 intake during the period 1944–72, no death rates were higher than expected and no positive dose-response trends were detected.

What are the current studies and public health activities at Mound?

Community Involvement

- Currently there are no ongoing studies with community involvement.

Off-Site Contamination

- Currently there are no ongoing studies assessing off-site contamination.

Community Health Studies and Activities

- A local citizens group, Miamisburg Environmental Safety and Health, is conducting a **neighborhood health survey**.

Occupational Health Studies

- Exposures encountered at Mound and other sites by **decontamination and decommissioning workers** are being characterized by NIOSH. Working conditions and research needs are being identified at each study site in this Phase I feasibility study. These results are relevant to current workers, and support development of surveillance activities.

- The State University of New York, sponsored by a NIOSH grant, is conducting a **mortality study of female nuclear workers** at 12 Facilities. This study will be the largest study of mortality among the 80,000 women ever employed in the DOE work force. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

What are the gaps in our knowledge and what important issues need to be addressed?

- Interest has been expressed in greater local involvement in studies and public health activities relating to Mound.

- There is a need to improve assessment of exposure to polonium-210 using current models that were not available during the previous cohort study.

- There is a need to assess the extent of off-site contamination from polonium-210, plutonium-238 and tritium releases.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- ATSDR will prepare a **health consultation** which addresses historic records that were unavailable during the preparation of the public health assessment. The records primarily cover the period 1950–1959.

- There will be a NIOSH **Update of Cohort Mortality Study of Mound Workers**. The Mound Plant has engaged in operations involving exposures to polonium -210, plutonium -238, and tritium. A mortality study through 1979 showed elevated levels of lung cancer mortality in workers employed from 1943–1959 and a significant dose-response relationship between external ionizing radiation exposure and lymphopoietic/hematopoietic cancers and leukemia. An update would provide an additional 16 years of followup and the use of validated bioassay data.

Public Health Activities Site Plan

Nevada Test Site

Nye County, Nevada

Background

The Nevada test site (NTS) is in Nye County in southern Nevada. The site contains 1,350 square miles of federally owned land, and access to the site is restricted. The first nuclear weapons tests on the site were in 1951 and it was made a permanent location by land withdrawals beginning in 1952. The site was created from a portion of the land that the Air Force used as a bombing and gunnery range; the gunnery range is now known as the Nellis Air Force Range. The Nevada test site was created to accelerate the development of nuclear weapons. The combined area of the Nevada test site, the Nellis Air Force Range, and the contiguous Tonopah Test Range is approximately 5,470 square miles.

NTS has an extensive history of nuclear weapons tests, with 119 atmospheric tests conducted in the years 1951–1958 and 809 underground tests conducted in 1961–1992. The atmospheric tests resulted in radioactive fallout being deposited downwind and across the world. The underground tests resulted in large quantities of radionuclides being retained in the soil and groundwater. There have been low-level radioactive waste shipments from other Department of Energy (DOE) facilities to two NTS waste site disposal locations. One disposal site opened in the late 1960s and the other in 1978. The proposed Yucca Mountain high-level radioactive waste repository is also partially located on the property of the Nevada test site. There could be a significant increase of shipments of low-level radioactive wastes (more than 200,000 by some estimates) if plans are approved for designating the Nevada test site as a regional waste disposal center.

What have we learned from our studies and assessments of the Nevada test site?

Off-Site Contamination

- In 1997, the National Cancer Institute (NCI) published **estimated thyroid doses** for populations of each US county due to releases of iodine-131 during atmospheric nuclear weapons testing at NTS in the 1950s and 1960s. For the entire US population, the average cumulative thyroid dose was about 2 rads. The average thyroid dose in the 24 counties with the highest exposures (located in Nevada, Utah, Idaho, and Montana) ranged from 9–12 rads. The National Academy of Sciences Institute of Medicine reviewed the cancer study and concluded that resources be focused on designing an education and information program about health

consequences of exposure to fallout from the site. The Institute of Medicine did not recommend conducting widespread thyroid screening programs.

Community Health Studies and Activities

- During the 1980s, scientists at several national laboratories collected all records and data pertaining to U.S. atmospheric nuclear weapons testing into a single collection. This collected material was housed in the DOE Coordination and Information Center in Las Vegas, and made available to the public. From this data, a **dosimetric evaluation** of areas in the region was developed. The study was characterized by community/locale and age/occupation. The study found that residents in southwest Utah closest to the Nevada test site received the highest exposures (whole body doses of less than 10 rems), but that residents of urban northern areas received a higher mean dose. Subsequent epidemiologic studies used this methodology and the models and data to estimate doses for certain cohorts and populations. The Offsite Radiation Exposure Review Project established exposures from NTS fallout.

- A number of studies have examined the possibility of adverse health effects from radioactive fallout to people living near the Nevada test site; these studies have usually focused on **thyroid disease and leukemia in children** downwind of the site. Early studies of thyroid diseases found no association between occurrence of disease and living near the site. However, a 1993 study that included calculated thyroid doses reported a statistically significant dose-response trend of increased thyroid neoplasms with increased radiation dose. The relative risks of thyroid cancer for higher dose levels were elevated, but were not statistically significant. Studies of cancer and leukemia have generally found excesses in forms of leukemias considered radiogenic. The latest study, a 1990 case-control study of leukemia deaths in Utah, found a positive dose-response relationship for the acute leukemias (acute lymphocytic in particular) in persons less than 20 years old. A weak overall relationship was found. However, the excess was confined primarily to a single, sparsely populated county.

Studies of the Health of Workers

- Studies are underway on workers at NTS, however, no completed studies on the health of current or past workers are available.

What are the current studies and public health activities at the Nevada test site?

Community Involvement

- In 1981 the Community Radiation Monitoring Program began. The program now has a Citizens Advisory Board which meets regularly.

Off-Site Contamination

- There is a milk surveillance network and sampling of wells supplying drinking water.

Community Health Studies and Activities

- Nye County, working with representatives from ten county governments, and the University of Nevada at Las Vegas has completed a first draft of the Nevada Baseline Rural Health Assessment Research Proposal, a Baseline Radiation Health Study Bibliography, and initiated organization of an independent Nevada Health Study Advisory Group.

- NCEH has a cooperative agreement with the Ely Shoshone Tribe to examine the feasibility of conducting a health study among exposed tribal members.

Occupational Health Studies

- Boston University, in a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH), is evaluating the effects of **job stressors including downsizing and reorganization** in a multisite study. Organizational climate, worker health, and performance at four DOE sites will be assessed.

- The first phase of the **DOE Medical Surveillance for Former Workers at NTS** reviewed available information that will help determine whether former workers might develop health problems due to their employment at the site. The focus is on construction workers in underground and excavation work and re-entry workers who were employed there from 1951–1992. About 15,000 workers who were represented by six construction trade unions were identified for the cohort study. Exposure information and health data are being collected, and the former workers are being contacted. In the second phase of the study, Boston University investigators will determine which workers might possibly be at significant risk for health problems related to their exposure and those workers will be offered an opportunity to participate in a free medical screening program.

What are the gaps in our knowledge and what important issues need to be addressed?

- Gap in understanding of health effects to workers and community members, including special populations such as Native Americans.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects, if feasible and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment including local communities and their governments, appropriate agencies of the State of Nevada, and the NTS Citizens Advisory Board.

New Activities for FY 1999 and FY 2000

- In February 1998, Governor Bob Miller requested **technical assistance** from the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR agreed to provide technical assistance and review the environmental and health concerns.

- ATSDR, the National Center for Environmental Health, and the National Institute for Occupational Safety and Health will work with other Department of Health and Human Services agencies in developing **educational materials** and programs for the public, health care providers, media, public health agencies, and professional organizations related to health risks from past exposures to environmental releases of hazardous materials from the Nevada test site.

- ATSDR, the National Center for Environmental Health, and the National Institute for Occupational Safety and Health will coordinate with the State and communities to develop a **community health communication strategy** and ensure that findings from their NTS-related activities are communicated to all interested stakeholders and the public.

Activities for which the Funding Source is External to the Department of Energy and Department of Health and Human Services Memorandum of Understanding

A focused program of public information and education about the consequences of the NTS fallout will be developed in coordination with the State of Nevada and Health Study Advisory Groups. The following activities address fallout from the Nevada test site.

- The cohort of **former Utah schoolchildren** who were previously evaluated for thyroid disease in relation to fallout exposures from the Nevada test site will be followed up for the second time.

- The National Center for Environmental Health (NCEH) is assessing the feasibility of conducting a nation-wide comprehensive assessment of the health consequences of nuclear weapons tests. General and specific high-risk populations will be considered.

- NCEH will collaborate with the National Cancer Institute in implementing the **public health outreach** recommendations contained in the report prepared by the National Academy of Sciences and Institute of Medicine on the effects of NTS-related radioactive iodine exposures to people across the United States.

Public Health Activities Site Plan

Oak Ridge Reservation

Oak Ridge, Tennessee

Background

The Oak Ridge Reservation currently occupies approximately 37,000 acres of land in two counties, Anderson and Roane, in east central Tennessee. Most of the reservation is within the limits of the city of Oak Ridge. The federal government established the Oak Ridge Reservation in 1942 as part of the Manhattan Project, the World War II effort to build the atomic bomb. Originally, the site was 58,000 acres. There are three major installations on the reservation: the Y-12 weapons plant; East Tennessee Technology Park, formerly known as the K-25 site; and the Oak Ridge National Laboratory, formerly known as the X-10 site. These installations occupy about 30% of the reservation property. The remainder of the property, which was never used for nuclear weapons production, research processes, or waste management, is designated as a National Environmental Research Park.

In the early years, the Oak Ridge Reservation missions were plutonium production and uranium enrichment. After the war, the installation's role broadened widely to include a variety of nuclear research and production projects vital to national security. In recent years, the facilities and expertise developed and maintained in the interest of the national defense have been downsized. Presently, missions include environmental restoration, decontamination and decommissioning, waste management, research and development related to energy, technology transfer, government and industry partnerships, and national security programs.

In addition, operations at the Oak Ridge Reservation have left a legacy of radioactive and chemical waste requiring management and disposal. Old waste sites occupy 5% to 10% of the reservation. Most of these waste sites lack engineered containment structures. The chemical and radioactive materials in these waste sites have contaminated soil, groundwater, and surface water both on and off the reservation.

What have we learned from our studies and assessments about Oak Ridge?

Off-Site Contamination

- In 1983 the Tennessee Department of Health and Environment and the Centers for Disease Control and Prevention (CDC) National Center for Environmental Health (NCEH) conducted a pilot **survey** in Oak Ridge in response to community concerns about mercury contamination in the East Fork Poplar Creek floodplain and the sewer

line beltway. The pilot survey concluded that residents and workers in Oak Ridge, Tennessee, are not likely to be at increased risk for having significantly high mercury levels. Mercury concentrations in hair and urine samples were below levels associated with known health effects.

- In 1992 an Oak Ridge physician requested the Agency for Toxic Substances and Disease Registry (ATSDR) to **review clinical data and medical histories** of 45 patients in the Oak Ridge area. ATSDR and the Tennessee Department of Health reviewed the data and concluded that the case series referred by the physician did not provide sufficient evidence to associate low levels of metals with the diseases presented in the physician's patients. In addition, Howard Frumkin, MD, DrPH, of the Emory University School of Public Health, conducted individual clinical evaluations of the Oak Ridge physician's patients and did not report any hazardous substance exposure to public health agencies.

- Additional studies were conducted of hazardous substances in **East Fork Poplar Creek**. Following are some of the conclusions of a 1993 ATSDR health consultation. Soil and sediments in certain locations along the East Fork Poplar Creek floodplain are contaminated with levels of mercury that pose a public health concern. Fish in the creek contain levels of mercury and PCBs that pose a moderately increased risk of adverse health effects to people who eat fish frequently over long periods of time. The state of Tennessee has posted no fishing signs, however, and the creek is not normally used as a source for fish. Although shallow groundwater along the East Fork Poplar Creek floodplain contains metals at levels of public health concern, this water is not used for drinking or other domestic purposes.

- A 1995 ATSDR health consultation concluded that the **East Fork Poplar Creek** floodplain soil clean-up level of 400 milligrams per kilogram (mg/kg) for mercury is protective of public health and will pose no health threat to children or adults. In 1996, DOE cleaned up all areas along the East Fork Poplar Creek floodplain where the soil was contaminated with mercury at levels above 400 mg/kg.

- A 1996 ATSDR health consultation on the **Watts Bar Reservoir** reported the following conclusions. Fish in the reservoir contain PCBs, and frequent and long-term ingestion of these fish poses a possible moderately increased risk of cancer. Frequent and long-term ingestion may also increase the possibility of developmental effects in infants whose mothers consume fish regularly during gestation and while nursing. Current levels of contaminants in the surface water and sediment of the reservoir were not at levels of public health concern, and the reservoir was determined to be safe for swimming, skiing, boating, and other recreational purposes. Water from the municipal water systems was determined to be safe to drink. The health consultation reported that public health would be protected by DOE's remedial actions, which included maintaining the fish consumption advisories; continuing environmental monitoring;

implementing institutional controls to prevent disturbance, resuspension, removal, or disposal of contaminated sediment; and providing community and health professional education on PCB contamination.

- A 1997 ATSDR exposure investigation on the **Watts Bar Reservoir** reached the following conclusions. The serum PCB levels and blood mercury levels in participants in the investigation (these were people who consumed moderate to large amounts of fish or turtles from the reservoir) are very similar to levels found in the general population. Only 5 of the 116 people tested (4%) had PCB levels higher than 20 micrograms per liter (20 parts per billion), which is considered to be an elevated level of total PCBs. Of the 5 participants who exceeded 20 micrograms per liter, 4 had levels of 20–30 micrograms per liter. Only one participant had a serum PCB level of 103.8 micrograms per liter, which is higher than the general population distribution. Only one participant in the exposure investigation had a total blood mercury level higher than 10 micrograms per liter, which is considered to be elevated. The remaining participants had mercury blood levels that ranged up to 10 micrograms per liter, as might be expected to be found in the general population.

- Additional studies were conducted for East Tennessee Technology Park. A 1997 **Governor of Tennessee's Independent Panel Report on the DOE Toxic Substances Control Act (TSCA) Incinerator at the East Tennessee Technology Park** concluded that the TSCA incinerator facility and operating conditions were in harmony with its permit and had experienced few operating violations. The amount of waste actually burned is a small fraction of the volume that the incinerator was designed for and permitted to process. The highest concentrations measured by the site monitors were but a small fraction of the permissible levels, and most pollutants that were measured were not primarily from the TSCA incinerator.

Community Health Studies and Activities

- In 1991, the Tennessee Department of Health entered into an Oak Ridge health study agreement with the Department of Energy (DOE), and decided to perform an **environmental dose reconstruction study** to evaluate all past operations and releases of hazardous substances from the Oak Ridge Reservation. After screening the releases of hundreds of substances used at the Oak Ridge Reservation, five were studied in further detail. The more detailed studies were needed to estimate the amounts of the hazardous substances released and to estimate past (prior to 1990) exposure (or doses) of these substances to people off the reservation. These estimated doses will be used to determine which off-site populations were exposed to hazardous substances and what resulting adverse health effects they might experience. In 1999 the following study conclusions were reported.

- **Radioactive iodine** releases were associated with radioactive lanthanum processing at X-10 during 1944 through 1956. Results indicate that children born in the area in the early 1950s who drank backyard cow's or goat's milk had an increased risk of developing thyroid cancer. Within a 25-mile radius of Oak Ridge, it is likely that these children had an increased risk of more than 1 in 10,000 of developing thyroid cancer.

- The study evaluated **mercury** releases associated with lithium separation and enrichment operations at the Y-12 plant during 1955 through 1963. Results indicate that during the years mercury releases were highest (midfifties to early sixties), individuals may have engaged in activities that resulted in their receiving annual averages doses of mercury that exceeded the reference dose. The reference dose for a substance is an estimate of the largest amount of a substance that a person can take in on a daily basis over their lifetime without experiencing adverse health effects.

- Additional studies were conducted on **polychlorinated biphenyls** (PCBs) in fish from the East Fork Poplar Creek, Clinch River, and the Watts Bar Reservoir. Preliminary results indicated that individuals who consume a large amount of fish from these waters may have received doses that exceeded the reference dose for PCBs.

- **Radionuclides** associated with various chemical separation activities at X-10 from 1943 through the 1960s were released via White Oak Creek. Eight radionuclides deemed more likely to carry significant risks were studied. The results indicate that the White Oak Creek releases caused small increases in radiation dose in consumers of fish from the Clinch River near the mouth of White Oak Creek. However, less than one excess cancer case is expected from 50 years of fish consumption.

- **Uranium** was released from various large-scale uranium operations, primarily uranium processing and machining operations at the Y-12 plant from 1944–1988 and uranium enrichment operations at the K-25 and S-50 plants. Because uranium was not initially given high priority as a contaminant of concern, a Level II screening assessment for all uranium releases was performed. Preliminary screening indices are slightly below the decision guide of one chance in 10,000, indicating that more work may be needed to better characterize uranium releases and possible heath risks.

- The Tennessee Department of Health conducted **health statistics reviews** in 1992 to compare cancer incidence rates (1988–1990) and in 1994 to compare mortality rates (1980–1992) of counties surrounding the Oak Ridge Reservation to rates from the rest of the state. The reviews concluded that some rates were elevated and others were

low compared to the state rates and that no patterns were identified as related to the Oak Ridge Reservation.

- The ATSDR **health education program** was conducted to inform local residents and physicians of the health risks associated with PCBs in fish in the Watts Bar Reservoir. The education program consisted of a number of activities and programs including a community health education meeting held in Spring City, Tennessee. A physician and health professional education meeting was sponsored in Oak Ridge, Tennessee, for health care providers in the vicinity of the Watts Bar Reservoir. Copies of two publications from the ATSDR series of Case Studies in Environmental Medicine, "Polychlorinated Biphenyls" and "Taking an Exposure History" were sent to health specialists in the area. ATSDR, using input from a collaborative effort of local citizens, organizations, and state officials, developed an instructive brochure on the Tennessee Department of Environment and Conservation fish consumption advisories for the Watts Bar Reservoir.

- This ATSDR **physician education program** was conducted to provide information regarding the health impacts of possible cyanide intoxication and to assist community health care providers in responding to health concerns expressed by employees working at the East Tennessee Technology Park (ETTP). An environmental health education session for physicians was held at the Methodist Medical Center in Oak Ridge. ETTP employees and physicians were given copies of the ATSDR Case Studies in Environmental Medicine publication on cyanide toxicity, the final health hazard evaluation by the National Institute of Occupational Safety and Health, and the ATSDR public health statement for cyanide. ATSDR instituted a system through which local physicians could make patient referrals to the Association of Occupational and Environmental Clinics (AOEC).

- The 1998 CDC health investigation of the Scarboro community concluded that the results of the self-reporting health survey indicated elevated rates of asthma and wheezing. The asthma rate was 13% among children in Scarboro, compared to national estimates of 7% among all children aged 0–18 years and 9% among African American children aged 0–18 years, but is less that the 14.5% Chicago rate. The wheezing rate among children in Scarboro was 35%, compared to international estimates which range from 1.6% to 36.8%. No statistically significant association was found between exposure to common environmental triggers of asthma (such as environmental tobacco smoke, pests, unvented gas stoves, and the presence of dogs or cats in the home) or potential occupational exposures (for example, living with an adult who works at the Oak Ridge Reservation or living with an adult who works with dust and fumes and brings exposed clothes home for laundering) and asthma or wheezing illness. The physical examinations of 23 Scarboro children who were identified in the survey as possibly having asthma indicated that all were generally

healthy and no urgent health problems were identified. Only one child had any lower respiratory illness, and none were wheezing at the time of the physical examination.

Studies of the Health of Oak Ridge Workers

There have been numerous studies of health effects among workers at the Oak Ridge Reservation facilities. These studies, initially funded by DOE, have been conducted by researchers at the National Institute for Occupational Safety and Health (NIOSH) and various collaborators including the Oak Ridge Associated Universities, the University of North Carolina, and the University of Michigan. Study findings to date include the following.

- The Oak Ridge National Laboratory (X-10) has been the subject of long-term epidemiologic study. The first investigation of 8,375 white males analyzed deaths through 1977 and found no cause of death that was higher than expected based on the U.S. general population. However, leukemia mortality was related to length of employment in engineering and maintenance jobs. A follow up study reported that the death rate from leukemia through 1984 was greater than the U.S. rate, particularly among workers monitored for internal radiation contamination. A positive trend was reported for all cancers combined by level of cumulative external dose but not for leukemia. In the most recent study of deaths through 1990, none of the rates for the four causes of death reported, all causes of death combined, all cancers combined, lung cancer, and leukemia, was higher than the corresponding U.S. rates. A recent study of deaths through 1990 reported that radiation doses received after age 45 years strongly predicts the all cancers combined mortality rate; an earlier X-10 study noted that employees age 65 years and older at exposure were at higher risk.

- The first study of Y-12 workers included 18,869 white males who ever worked at the plant and mortality through 1974 was identified. The second study was restricted to 6,781 men who worked at least 30 days with mortality through 1979. A third study was expanded to include 10,597 nonwhite workers and females with deaths through 1990. The death rate from lung cancer was higher than the U.S. rates in the most recent two studies. Analysis of deaths through 1979 did not confirm positive trends for any cause of death with either external or internal exposure to ionizing radiation although a weak trend was observed for lung cancer.

- Between 1953 and 1963 the Y-12 Plant used metallic mercury in a process to produce large quantities of enriched lithium. There were 5,663 workers categorized by exposure based on results of urinalysis data. Analysis of deaths through 1978 revealed no differences in the mortality patterns for mercury exposed workers as a whole, workers with the highest mercury exposures, and workers employed more than a year in a mercury process. 502 mercury workers were also involved in a clinical neurology study. Clinical measurements revealed some deficiencies in neurological

function particularly among those workers with the highest exposures, but these were not associated with the duration of exposure. A follow up study of 219 of the original subjects in the 1990s revealed that some neurologic effects were still detectable.

- During the early operation of the Y-12 plant from 1942–1947, a group of 694 male workers was exposed to phosgene gas on a chronic basis and 106 males received acute exposures along with 91 females. A control group of 9,280 workers who also worked at Y-12 during the same era, but who did not have phosgene exposure, was also described. All groups were followed through the end of 1978 with particular interest in respiratory diseases and lung cancer. There was no evidence for increased mortality from respiratory diseases in this group.

- Studies of workers at K-25 found that white males had high rates relative to the U.S. general population for all causes of death; cancer of the respiratory system, particularly lung cancer; bone cancer; mental disorders, all respiratory diseases, particularly pneumonia; symptoms, senility, and ill-defined conditions; all external causes of death, particularly accidents and specifically motor vehicle accidents. White females had a high rate for symptoms, senility, and ill-defined conditions.

- Powdered nickel was used at K-25 in the production of the barrier material used to separate and enrich uranium. Death rates for 814 nickel workers who fabricated the barriers were compared to 1600 controls. There were no differences in the death rates for the exposed and non exposed workers by cause of death through 1972. A later study compared the mortality through 1977 of the nickel workers and 7,552 non exposed workers. There were no causes of death with a rate higher than the U.S. rate and no differences between exposed and non exposed workers.

- Epoxy resins and solvents were common exposures among K-25 gas centrifuge workers. In Phase I of a study of centrifuge workers, a total of 263 workers with the most exposure were compared with 271 employees with no exposure at the plant during the same time period. The centrifuge process workers reported 5 incident bladder cancers versus none reported by the non-centrifuge group. The standardized incidence rate ratio was 7.8 for process workers vs. comparison workers. In Phase II of the study, a larger group was studied who had lower levels of exposure to the centrifuge process. One additional case was found in a centrifuge worker and two additional cases were found in maintenance workers who were assigned to work in centrifuge areas. An equal number of cases of bladder cancer were found in the comparison group in Phase II. A specific cause for the increase in bladder cancer was not identified.

- Several studies have considered all Oak Ridge workers. The most recent study updated mortality through 1984. Mortality from all causes of death combined and all cancers combined were similar to overall U.S. rates. There were substantial

differences in death rates among workers at the various Oak Ridge plants, particularly the rates for lung cancer, leukemia and other lymphatic cancer. Within the second study, data for 28,374 workers at X-10 and Y-12 were analyzed and positive trends were reported with increasing external radiation dose for all causes of death combined and all cancers combined.

Three studies of brain cancer across the four ORR facilities have been published. The exposure analysis of 26 chemicals found that none were positively associated with brain cancer. No positive trends for brain cancer were found with increasing external radiation dose and internal dose as measured by the lung dose. Although workers with brain cancer were more likely than other workers to have worked at ORR more than 20 years, there was no trend of increasing cancer with the number of years worked.

Mortality data through 1974 and through 1989 were analyzed for about 1059 white male welders at the Oak Ridge Reservation. No death rate was higher than the U.S. rate through 1974. When deaths through 1989 were considered, welders had higher rates of lung cancer, cancer of the prostate, and gastric ulcers. The risk of each cause was different among the facilities. The risk of lung cancer among welders exposed to nickel oxides did not differ from non-exposed welders.

- A multisite study of multiple myeloma deaths included workers from X-10. Although the death rate was not higher than expected, higher risks were encountered by workers whose radiation exposures occurred after age 45 years.

- A study of the potential association between paternal exposure to ionizing radiation and risk of **childhood cancer** found no evidence of a link between leukemia and paternal employment at Oak Ridge. Children whose fathers worked at Hanford were more likely to get CNS (central nervous system) cancer than children whose fathers worked at other sites, including Oak Ridge, but this finding was based on small numbers and was not statistically significant.

- A NIOSH health hazard evaluation, requested by K-25 site employees, investigated possible worker exposure to **cyanides**. The evaluation indicated that employees are not occupationally exposed to hydrogen cyanide, cyanide salts, or a wide variety of other compounds that contain the cyanide ion.

- The Oak Ridge National Laboratory, sponsored by a NIOSH grant, investigated **statistical estimation of dose** from daily and weekly dosimetry data for Oak Ridge radiation workers included in previous epidemiologic studies. The study found that differences between the two methods was substantial, and recommended methods of reducing uncertainty for some estimates.

- The Oak Ridge Associated Universities, under a NIOSH grant, developed a project at the Oak Ridge site to develop a **system for the prioritization of industrial hygiene and medical surveillance** efforts. The Worker Exposure Surveillance System (WESS) was designed for easy data merger with traditional occupational health systems utilizing environmental level analyses, occupational titles, and area descriptors.

- The University of Cincinnati, sponsored by a NIOSH grant, created **exposure histories for the construction trades** at the Oak Ridge site. This study developed techniques for improving the characterization of worker occupational exposures over time, especially worker recall of complex occupational exposures across a large number of short-term workplace assignments. These new techniques, including graphic displays of work site locations and detailed building histories, will be validated at another DOE site and used to establish guidelines and formats for the maintenance of personal work histories.

What are the current studies and public health activities at Oak Ridge?

Off-Site Contamination

- The ATSDR **public health assessment** on the Oak Ridge Reservation will assess the public health impact on off-site populations from releases of hazardous substances from the Oak Ridge Reservation and determine which public health actions or studies are indicated. On an ongoing basis, ATSDR is conducting the public health assessment to identify and characterize both current and past exposures of off-site populations to radiologic and chemical contaminants. ATSDR will also evaluate morbidity and mortality data to identify increased rates of health outcomes associated with contaminants of concern. The public health assessment will (1) identify people exposed at levels of health concern; (2) identify increased rates of health outcomes; (3) address community health concerns; and (4) recommend follow-up public health actions or studies. To avoid any duplication of effort, ATSDR will use the data and information collected by Tennessee Department of Health during their environmental dose reconstruction project.

Community Studies and Activities

- There is a continuing need to address **environmental justice issues**. DOE's Oak Ridge Operations Office maintains a formal and active Environmental Justice Plan consistent with Executive Order 12898, to address environmental justice in minority populations and low-income populations, at and around the ORR facilities. The Executive Order requires Federal agencies to make achieving environmental justice a part of their mission. As well, the University of Tennessee is partnering with numerous East Tennessee urban and rural grassroots community groups, including

those with special interest in ORR activities, to understand and address the core problems facing low- and moderate-income communities.

Occupational Health Studies

- The **DOE Beryllium Worker Medical Surveillance Program** is designed to detect and diagnose chronic beryllium disease (CBD) among current and former workers exposed to beryllium throughout the DOE complex, including Oak Ridge. Information from this program is used to improve and evaluate worker protection and control measures, to monitor trends in CBD frequency, and to strengthen work planning to minimize worker exposures. This program includes an intensive, coordinated health-risk communication effort.

- **DOE's Former Worker Program** is a pilot program designed to provide medical surveillance for selected former DOE workers at risk of work-related illness as a result of exposures while working at DOE facilities. Two projects are underway in Oak Ridge.

    - The **former construction workers** project is led by Dr. Eula Bingham of the University of Cincinnati in cooperation with the United Brotherhood of Carpenters Health and Safety Fund, the Center to Protect Workers' Rights, and Duke University Medical Center. The Phase I assessment identified approximately 800 former construction workers. Phase II will focus on medical screening of workers exposed to asbestos, beryllium, noise, silica, solvents, and heavy metals.

    - The second project involving **former production workers** from the Oak Ridge K-25, Paducah, and Portsmouth gaseous diffusion plants is led by Dr. Steven Markowitz of Queens College, City University of New York, and Mr. Robert Wages of the Oil, Chemical, and Atomic Workers International Union, in cooperation with the University of Massachusetts at Lowell. The Phase I assessment identified approximately 1,260 former production workers as potentially at high risk. The Phase II will focus on medical screening of workers exposed to asbestos, beryllium, bladder carcinogens, chlorinated solvents, fluorine compounds, nickel, noise, silica, uranium, welding fumes, and heavy metals.

- An independent panel of nationally recognized occupational health physicians is conducting individual **medical evaluations to assess occupational health complaints and symptoms** of 53 current and former Lockheed Martin Energy Systems workers at the East Tennessee Technology Park (formerly called the Oak Ridge K-25 site). These medical evaluations of the workers include reviews of prior health studies; visits to workers' workplaces and environs; work history interviews with individual workers; reviews of worker medical records; physical examinations; and specialized follow-up inquiries and testing.

- Boston University, in a cooperative agreement with NIOSH, is evaluating the effects of job stressors including **downsizing and reorganization** are being evaluated in a multisite study. Organizational climate, worker health, and performance at four DOE sites will be assessed.

- The United Brotherhood of Carpenters Health and Safety Fund, sponsored by a NIOSH grant, is conducting a study of **carpenters and other construction workers** at Oak Ridge. The study will assess the effects of heat stress associated with wearing protective clothing. Physiologic and neurobehavioral changes of workers will be measured during actual work conditions. Carpenters and other construction workers in remediation and hazardous waste work will benefit from this information.

- The State University of New York, sponsored by a NIOSH grant, is conducting a study of **mortality among female nuclear weapons workers**. This study of female workers from 12 DOE plants will be the largest study of mortality among the 80,000 female workers who have ever been in the DOE work force. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards

.

- Two ongoing NIOSH case-control studies combine worker information from multiple sites including Oak Ridge to answer study questions about specific cancers. One study is being conducted to clarify the relationship between **lung cancer** and external radiation exposure. The second case-control study, the largest of its kind, is exploring the relationship between external radiation and **leukemia** risk among 250 workers with leukemia compared to similar workers without leukemia.

- Limited previous studies outside the DOE complex suggest an increased risk of cancer in **chemical laboratory workers**. In this study worker potential exposures to groups of chemicals and ionizing radiation will be assessed and their relationship to mortality patterns will be investigated.

- Exposures encountered by **decontamination and decommissioning** workers at Oak Ridge and other sites are being characterized by NIOSH. Working conditions and research needs are being identified at each study site in this Phase I feasibility study. These results are relevant to current workers, and support development of surveillance activities.

- A NIOSH **multiple myeloma case-control study** at Oak Ridge's K-25 facility will increase understanding of the relationship between multiple myeloma and different types of radiation exposure. A previous study at the University of North Carolina examined the relationship between multiple myeloma and exposures to external radiation and chemicals. The current NIOSH study will look at the relationship between multiple myeloma and exposures to internal radiation and chemicals.

What are the gaps in our knowledge and what are the important issues which need to be addressed?

- A more effective public forum should be developed with the broader Oak Ridge community and state and federal agencies with regard to public health activities at the Oak Ridge Reservation.

- Process for evaluating the necessity for and criteria for possible **clinical intervention** in the community.

- Knowledge of possible soil contamination levels in residential areas closest to the ORR plants.

- Evaluation of current monitoring systems and atmospheric dispersion models to determine if they are appropriate for the materials in use and the pathways.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were previously mentioned and initiate new projects to address the health conditions of the Oak Ridge area. New activities will be implemented only if feasible and deemed appropriate and beneficial to the community.

New Activities for FY 1999 and FY 2000

- The highest priority for the state and federal agencies at the Oak Ridge Reservation is to **develop a forum** whereby community members, local interest groups, and state and federal agencies can work collectively to make informed recommendations regarding the public health agenda for the Oak Ridge Reservation. This forum will enable state and federal agencies to interact with local interest groups. The agencies will have the opportunity to present to community members the results of previous studies, analyses of exposure pathways, results of the health statistics review, and the criteria used to select and conduct appropriate public health activities.

  Community members will help **prioritize public health issues and community concerns** and provide input into the choices to be made between current and historical exposures and different public health activities. Discussion between the groups will provide an opportunity for education and collaboration. Local interest groups and state and federal agencies can work together in developing the health agenda for Oak Ridge. The agencies will address the public health concerns of the community and will

present and discuss their findings and any recommendations for further studies or additional public health actions.

The following topics have been suggested for discussion in conjunction with the public forum (1) the procedures for establishing medical cause and effect, (2) the limitations of epidemiology, and (3) the difficulties of dealing with residential or other ill-defined clusters including small sample sizes.

- DOE plans to expand the **Former Worker Medical Surveillance Program** to current workers and additional former workers at the three gaseous diffusion plants.

Public Health Activities Site Plan

Paducah Gaseous Diffusion Plant

Paducah, Kentucky

Background

The Paducah Gaseous Diffusion Plant (PGDP) is a uranium enrichment facility covering approximately 1,350 acres in western McCracken County. It is approximately 10 miles west of Paducah, Kentucky, and about 3 miles south of the Ohio River. The Paducah plant began operating in 1952. Previously the site and surrounding areas were used as a World War II-era ordnance facility known as the Kentucky Ordnance Works. Currently, the plant is leased and operated by the United States Enrichment Corporation (USEC) to produce low-enriched commercial power reactor fuel. The Department of Energy (DOE) owns the site and retains responsibility for environmental remediation activities and waste generated prior to July 1, 1993, when USEC assumed responsibility.

The entire PGDP reservation covers a total of 3,424 acres, with approximately 750 acres in a fenced security area and an uninhabited buffer zone surrounds the fenced area. Beyond the DOE-owned buffer zone is an extensive wildlife management area of 2,100 acres deeded or leased to the Commonwealth of Kentucky.

PGDP performs the first step in the uranium enrichment process, enriching uranium-235 (U-235) in a physical separation process. The separation process is based on the fact that U-235 diffuses through a barrier at a faster rate than the heavier uranium-238. Subsequent to the separation processing at the Paducah plant, the uranium is further enriched at another DOE gaseous diffusion plant. Extensive support facilities are required to maintain the Paducah diffusion process, including a steam plant, four major electrical switchyards, four sets of cooling towers, a building for chemical cleaning and decontamination, a water treatment plant, maintenance facilities, and laboratory facilities. The site also includes a raw-water treatment plant, a residential landfill, an inert landfill, a former sanitary landfill, and two industrial treatment lagoons.

What have we learned from our studies and assessments of PGDP?

Off-Site Contamination

- In August 1988, DOE found **technetium-99** (Tc-99) in an off-site drinking water well north of the Paducah plant site. **Trichloroethylene** (TCE) has also been detected in nearby private wells and on-site and off-site monitoring wells. The contaminated

residential wells are no longer being used. Approximately 1,400 people obtain drinking water from public and private wells within 4 miles of the plant.

- Plant operations have generated hazardous, nonhazardous, and radioactive wastes, including chromium, heavy metals, polychlorinated biphenyls (PCBs), Tc-99, TCE, and uranium (multiple isotopes). DOE has detected **PCBs** in on-site surface water and downstream of the plant in Big Bayou Creek and in Little Bayou Creek. These creeks pass through the West Kentucky Wildlife Management Area, which is adjacent to the plant and to private property. Access to Little Bayou Creek is currently restricted, but Big Bayou Creek is occasionally used for fishing. In 1989, the commonwealth of Kentucky's Division of Water warned against consumption of fish caught in Little Bayou Creek and in several of the ponds in the wildlife management area.

HHS Community Health Studies and Activities

- There are no HHS community health studies or activities at the Paducah site.

Studies of the Health of PGDP Workers

- There are no health studies of workers at the Paducah plant.

What are the current studies and public health activities at PGDP?

Community Involvement

- **Community involvement** activities initiated by the Agency for Toxic Substances and Disease Registry (ATSDR) have included written correspondence, telephone conversations, informal meetings, and public availability sessions. ATSDR has also participated in and encouraged community involvement in DOE-sponsored public meetings. ATSDR solicited public concerns through direct mail inquiry, mailing approximately 1,700 packages. Approximately 500 responses were received from community members. Among other educational material, information on methods of preparing fish to reduce the possibility of PCB-exposure was provided to community members during the public availability sessions.

Off-Site Contamination

- ATSDR is conducting a **public health assessment** at PGDP. The main public health issues around the plant are potential off-site exposures to air releases, contaminated biota, surface water releases, and contaminated groundwater. The contamination includes both chemicals and radioactive materials. ATSDR is also looking at potential hazards presented by the outdoor storage on the site of thousands of cylinders, the majority of which contain depleted uranium hexafluoride.

Community Health Studies and Activities:

- There are no community health studies.

Occupational Health Studies

- The **DOE Former Worker Medical Surveillance Program at DOE Gaseous Diffusion Plants** involves former production workers from the Oak Ridge K-25, Paducah, and Portsmouth gaseous diffusion plants. The project is led by Dr. Steven Markowitz of Queens College, City University of New York, and Mr. Robert Wages of the Oil, Chemical, and Atomic Workers International Union, in cooperation with the University of Massachusetts at Lowell. The Phase I needs assessment was completed in 1997. The Phase II medical screening began in late 1998 and is scheduled to run through 2001. Initially, approximately 200–300 former Paducah production workers were identified as potentially at high risk for lung disease. A second priority group includes approximately 2,000 workers at Paducah. Exposures of concern that were identified in Phase I and that will be focused on during the Phase II medical screening include asbestos, beryllium, bladder carcinogens, chlorinated solvents, fluorine compounds, nickel, noise, silica, uranium, welding fumes, and heavy metals (for example, cadmium, lead, and mercury).

What are the gaps in our knowledge and what important issues need to be addressed?

- There is concern about past worker exposure to plutonium and other transuranics.

- For many of the off-site samples, there is no information to identify whether they were collected on or near residential properties.

- There is inadequate air monitoring data for hexavalent chromium, sulfur dioxide, and nitrogen oxides: chemicals that are released or have potential for release at levels of concern.

- Health outcome data for the immediate area around PGDP is not available. The populations of concern for the potential pathways of exposure in the area around the PGDP are extremely small, and the data available cover an area that is too large to demonstrate an impact from the site.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- Based upon the review of data used in developing the public health assessment, drinking water exposure to TCE via residential wells has been documented at levels of concern. Fish consumption advisories are in effect due to PCB and mercury contamination. Other contaminants of concern are chromium, lead, PCBs, uranium, volatile organic compounds, and Tc-99. ATSDR will review the exposure pathways and evaluate the potential health impact to consider appropriate **follow-up health activities**. The population closest to the site and potentially affected by these contaminants is estimated to number less than100.

- ATSDR will implement **health care provider training** in the Paducah community. Primary care providers will be given information and resources on diagnosing, treating, and counseling to increase their capacity to assist community members who are concerned about the health impact of the plant.

- ATSDR will implement **community health education** and communication strategy. Working with the Paducah community to identify the community's needs for information and education, a comprehensive health education outreach program will be developed. The purpose of this program will be to assure that community members know the issues of concern for the Paducah site; understand the science and the process of the various site studies; know how to protect themselves from exposure; know where to get their questions answered; and will be able to share their knowledge with others. Local community infrastructure, including schools, churches, community organizations, media, or other avenues identified by the communities, will be used to provide community health education outreach.

- DOE plans to expand the **Former Worker Medical Surveillance Program** to current workers and additional former workers at the three gaseous diffusion plants.

Public Health Activities Site Plan

Pantex Plant

Carson County, Texas

Background

The Pantex Plant is in Carson County, Texas, approximately 17 miles northeast of Amarillo. The area is primarily agricultural. The plant is owned by the Department of Energy (DOE) and operated under contract by Mason and Hangar-Siles Mason Company. The plant itself covers 9,100 acres. In addition, there is a buffer zone consisting of a 1,077-acre portion of Pantex Lake owned by DOE and 3,170 acres of land which DOE leases from Texas Technological University.

The plant began in 1942 as an Army Ordnance Corps facility. Nuclear operations began in 1950. Pantex is an active, operational site. The site's current mission is to assemble nuclear weapons for the nation's stockpile; disassemble nuclear weapons being retired from the stockpile; evaluate, repair, and retrofit nuclear weapons in the stockpile; demilitarize and sanitize components from dismantled nuclear weapons; provide interim storage for plutonium pits from dismantled nuclear weapons; develop, fabricate, and test chemical explosives and explosive components for nuclear weapons; and support DOE initiatives. The schedule calls for up to 2,000 weapons to be dismantled each year until the stockpile has decreased to a predetermined number. Dismantlement is estimated to be completed by 2004. Past and present waste practices include burning chemical wastes in unlined pits, burying construction and/or demolition debris including asbestos in unlined landfills, and discharging plant waste waters into surface water on the site.

What have we learned from our studies and assessments of Pantex?

Off-Site Contamination

- The Agency for Toxic Substances and Disease Registry (ATSDR) **public health assessment** categorized the site as "no apparent public health hazard" to the off-site community. This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below levels expected to cause adverse health effects.

Community Health Studies and Activities

- In evaluating citizens' public health concerns, ATSDR obtained the assistance of the Bureau of Epidemiology of the Texas Department of Health (TDH). Community members questioned excessive birth defect rates; excessive cancer rates in Armstrong,

Carson, Potter, and Randall counties; and other adverse health effects that they believed to be associated with environmental releases from the site. Specifically, TDH looked at records for **bone, brain, breast, leukemia, lung, prostate, and thyroid cancer and all types of cancer combined**. They found a higher than expected number of the following: (1) females who have cancer (all types combined) in the combined Potter/Randall counties area; (2) males who have chronic lymphocytic leukemia in the combined Potter/Randall counties area; (3) males who died from prostrate cancer in Potter and Randall counties; and (4) males who died from cancer (all types combined) in Potter County. Although the number of cases or deaths reported for some types of cancers in those counties may be higher than expected in comparison with numbers for other populations, an ATSDR review of available environmental data indicated that it is unlikely that area residents come into contact with significant enough amounts of chemicals or radioactive substances from the plant to cause adverse health effects. Thus, exposure to off-site releases from the Pantex Plant is probably not the cause of the higher than expected incidence of cancer in this area.

- The number of children born in this area with certain categories of **birth defects** appears to be higher than expected based on similar birth defect information obtained for the entire state. To determine an underlying cause for the apparent increase, TDH evaluated parental occupation and place of employment and distribution of birth defects by zip code. No parental occupations or workplaces were notable. Few parents of children born with birth defects worked at the Pantex facility. Additionally, although one zip code near the plant (79107, which extends from the western edge of the Pantex Plant along the Potter County/Carson County border toward Amarillo) showed significant elevations for several birth defect categories, there was no consistent pattern among zip codes showing that closer proximity to Pantex increased the risk for birth defects.

- An investigation of the incidence of **low birth weight** in newborns concluded that, although the incidence was increased in Armstrong County, no data indicated that proximity to the Pantex Plant increased the risk for low birth weight.

- An evaluation of the number of people with **muscular dystrophy, multiple sclerosis, amyotrophic lateral sclerosis, and lupus erythematosus** in the area indicated a higher than expected number of deaths from all but lupus erythematosus. There was no consistent pattern of deaths from these diseases in the four-county area. In some instances, the number of deaths attributed to these diseases was elevated for males and not females; in other instances, the reverse was true. The causes of many of these diseases are not clearly understood. Detailed answers to questions about patterns of disease occurrence appear in the Public Health Implications and Community Health Concerns Evaluation sections of the public health assessment.

Studies of the Health of Pantex Workers

- An epidemiologic study of Pantex Plant workers was published in 1985. This study compared total and cause-specific mortality for Pantex Plant workers employed between 1951 and December 31, 1978, with expected cause-specific mortalities based on U.S. death rates. Significantly fewer deaths were observed in the workforce than would be expected based on U.S. death rates for the following causes of death: all cancers, arteriosclerotic heart disease, and digestive diseases. No specific causes of death occurred significantly more frequently than expected. Slightly elevated mortality ratios were observed for brain cancer and leukemia; neither excess was statistically significant. The four deaths from brain cancer all occurred among those who had worked at the plant less than 5 years. The four deaths from leukemia occurred with equal frequency among those who had worked at the plant a short time and those who had worked more than 15 years.

What are the current studies and public health activities at Pantex?

Community Involvement

- ATSDR and the National Institute for Occupational Safety and Health (NIOSH) will continue to work with the Pantex Citizens' Advisory Board, labor organizations, and community groups such as Serious Texans Against Nuclear Dumping (STAND) and Panhandle Area Neighbors and Landowners (PANEL).

Off-Site Contamination

- The Texas Natural Resource Conservation Commission and the Texas Department of Health, Bureau of Radiation Control continue to monitor off-site areas for compliance with regulations and discharge permit limits.

Community Health Studies and Activities

- On the basis of ATSDR's determination that the number of children born in the Pantex area with certain categories of birth defects appears to be higher than what would be expected, the Texas Birth Defects Monitoring Division expanded active **surveillance of birth defects** to the Panhandle Region beginning with 1998 deliveries.

Occupational Health Studies

- A NIOSH update of the cohort **mortality** study of the Pantex Plant expanded this cohort to include females and nonwhite males. Vital status was updated through 1995, and a standardized mortality ratio analysis was conducted. The cohort was also evaluated by statistical modeling to look for any dose response effects. A final report is

being prepared, and findings will be communicated in FY 2000. Although the plant's mission has changed, similar exposures will be encountered by current and future workers.

- Boston University, under a NIOSH grant, is evaluating the effects of **job stressors including downsizing and reorganization** in a multisite study. Organizational climate, worker health, and performance at four DOE sites will be assessed, including Pantex.

- Sponsored by a NIOSH grant, the State University of New York is conducting a **mortality study of female nuclear workers** at 12 facilities including Pantex. This study will be the largest study of mortality among the 80,000 women ever employed in the DOE work force. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

What are the gaps in our knowledge and what important issues need to be addressed?

Ongoing activities are addressing the known gaps.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway which were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- ATSDR will coordinate with community members to develop and implement a plan for **health education**. Topics could include outreach to the community to inform them about the risks of using contaminated groundwater from the perched aquifer.

Public Health Activities Site Plan

Portsmouth Gaseous Diffusion Plant

Piketon, Ohio

Background

The Portsmouth Gaseous Diffusion Plant is near Piketon in rural Ohio, approximately 55 miles south of Columbus. The Portsmouth plant enriches uranium for use as nuclear fuel in commercial power plants. The plant has been producing enriched uranium by the gaseous diffusion process since 1955. The United States Enrichment Corporation operates the plant for the Department of Energy (DOE). The plant enriches uranium in the chemical form of uranium hexafluoride. If released to the atmosphere, uranium hexafluoride will convert to uranium oxide and hydrogen fluoride in moist air.

What have we learned from our studies and assessments of Portsmouth?

Off-Site Contamination

- The Agency for Toxic Substances and Disease Registry (ATSDR) **public health assessment** concluded that site-related contamination and hydrogen fluoride releases pose no apparent public health hazard.

Community Health Studies and Activities

- As part of the public health assessment process, ATSDR identified a family with **neurofibromatosis,** type 1 (NF1), and notified the state health department. This disorder is not related to the Portsmouth plant. NF1 is an inherited dominant genetic disease and has been identified as the most common cause of childhood cancers. NF1 can cause café-au-lait spots, axillary freckling, neurofibromas, Lisch nodules, and learning disabilities.

- As part of the public health assessment, ATSDR reviewed data for causes of death for Pike, Ross, and Scioto counties in Ohio. The incidence of cardiovascular disease was significantly higher in Pike County than other Ohio counties. Scioto County appeared to have a slightly higher mortality rate from cancer. However, after age-adjusting the data for the population, the cancer rate falls in line with the rest of the state. Age-adjusting health outcome data is necessary to compare one county to another, because older subpopulations have higher rates of cancer and cardiovascular mortality. Age-

adjusting modifies the crude mortality rate to what it would be if the population were of standard age distribution.

ATSDR found that the age-adjusted rate for childhood cancer mortality in Pike County was roughly twice the national and state rates, but the number was too small to give a statistically reliable result. This rate was based on only 5 cancer deaths for the 13-year period from 1979 to 1991. None of the childhood cancers were of the same type and therefore could not be related to a common cause.

Because the community expressed concerns about releases of uranium hexaflouride, ATSDR reviewed health outcome data related to renal diseases. No increase in the renal failure rate was identified in surrounding communities.

Studies of the Health of Portsmouth Workers

- The mortality through 1992 of 8,877 Portsmouth Gaseous Diffusion Plant employees is being studied by NIOSH in relation to internal and external sources of ionizing radiation, uranium, nickel, and fluorines. Death rates were not higher than expected based on the U.S. general population rates. Analyses are continuing and results are expected in 2000.

What are the current studies and public health activities at Portsmouth?

Community Involvement

- There are no current HHS community involvement activities at Portsmouth.

Off-Site Contamination

- There are no current studies of off-site contamination at Portsmouth.

Community Health Studies and Activities

- No community health activities or studies are currently being conducted for the Portsmouth site.

Occupational Health Studies

- The **DOE Former Worker Medical Surveillance Program at Department of Energy Gaseous Diffusion Plants** involves former production workers from Oak Ridge K-25, Paducah, and Portsmouth. The project is led by Dr. Steven Markowitz of Queens College, City University of New York, and Mr. Robert Wages of the Oil, Chemical, and Atomic Workers International Union, in cooperation with the

University of Massachusetts at Lowell. The Phase I needs assessment was completed in 1997, and the Phase II medical screening began in late 1998 and is scheduled to run through 2001. Initially, approximately 1,260 former production workers were identified as potentially at high risk. Exposures of concern that were identified in Phase I and that will be focused on during the Phase II medical screening include asbestos, beryllium, bladder carcinogens, chlorinated solvents, fluorine compounds, nickel, noise, silica, uranium, welding fumes, and heavy metals (for example, cadmium, lead, and mercury).

- The **Portsmouth Gaseous Diffusion Plant Nested Case-Control Studies** were conducted as a followup to the completed cohort analyses. Because of undocumented neutron exposure and many confounders present at the facility, the National Institute for Occupational Safety and Health (NIOSH) performed case-control analyses for hematopoietic, lung, and stomach cancers to investigate possible dose-response relationships.

What are the gaps in our knowledge and what important issues need to be addressed?

- Gap in knowledge of the morbidity patterns of Portsmouth workers.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously.

New Activities for FY 1999 and FY 2000

- DOE plans to expand the **Former Worker Medical Surveillance Program** to current workers and additional former workers at the three gaseous diffusion plants.

Public Health Activities Site Plan

Rocky Flats Plant

Golden, Colorado

Background

The Rocky Flats Plant is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver. The facility originally covered 2,000 acres, but a 4,550-acre buffer zone was added in 1974. The main processing operations are confined to approximately 384 acres in the buffer zone. Since its establishment, the plants's major operation has been the fabrication and assembly of components for nuclear weapons. These operations used aluminum, beryllium, plutonium, stainless steel, and uranium. The facility recovered plutonium and also separated and performed research on americium. Releases of pesticides, plutonium, solvents, and tritium have contaminated groundwater, soils, and surface water sediments at various locations on the facility. The mission ended in 1992. Since that time, site personnel have been involved exclusively with cleanup, waste management, and decontamination and decommissioning activities.

Public health issues at Rocky Flats include plutonium exposures to workers cleaning up the site; exposures to the public from plutonium-contaminated soils being transported off the site during remediation; and inadequate record-keeping of those on the site at any given time (which may impact future exposure assessments). Because of several fires and other operational releases, plutonium has migrated off site and has contaminated soil and sediment surrounding the facility. Soil and groundwater have also been contaminated by leaking waste drums that contain trichloroethene and plutonium shavings. Public health concerns related to these releases have led the Colorado Department of Public Health and Environment to oversee the development of exposure assessments and dose reconstruction activities.

What have we learned from our studies and assessments of Rocky Flats?

Off-Site Contamination

- **Plutonium contamination** of soils and sediments has been documented beyond the boundaries of the federally owned land. Additionally, three evaporation ponds have contributed to nitrate contamination of groundwater.

- An Agency for Toxic Substances and Disease Registry (ATSDR) health consultation concluded that heavy metals and radioisotopes in environmental media associated with **Operable Unit 3** (off the site and to the east of the fence line) are present at levels below health hazard and that Operable Unit 3 could be safely released for public use.

Community Health Studies and Activities

- In October 1993, the **Health Advisory Panel** overseeing the Rocky Flats Historical Public Exposures Studies drew these preliminary conclusions about Phase I: (1) Community exposures from past Rocky Flats contaminant releases appear to be relatively small; (2) A 10-mile area east and southeast of the site received the highest radiation doses; (3) The key Rocky Flats contaminant releases were the radioactive metal plutonium (released from a fire in the plant in 1957 and from the 903 Pad from 1964 through 1969) and carbon tetrachloride (a solvent used to clean plutonium parts), which was emitted during routine industrial operations; (4) The highest plutonium exposures occurred before 1975.

- Carl Johnson examined **cancer incidence** from 1969–1971 among non-Hispanic whites in the Denver area to determine if exposure to a small concentration of plutonium and other radionuclides had increased the incidence of cancer. The author concluded that during the period studied, cancer incidence increased with increasing plutonium soil concentrations and that exposure of the public to low concentrations of plutonium and other radionuclides may affect the incidence of total cancer and cancers known to be associated with radiation exposure.

- Crump et al. re-examined the 1969–1971 Johnson data, and also analyzed data from a later period, 1979–1981. The authors' findings paralleled the earlier Johnson results for 1969–1971. For 1979–1981, significant positive trends were observed in males for total cancer, "radiosensitive cancer" (as defined by Biological Effects of Ionizing Radiation III), and respiratory cancer; and in females for total cancer, radiosensitive cancer, and gastro-intestinal tract cancer. The authors examined the possible effects of urbanization on cancer incidence by grouping census tracts by distance from the Colorado State capitol building. **Cancer incidence rates** were found to decrease in all directions from the capitol, including the direction of Rocky Flats. After controlling for distance from the capitol, the statistically significant association of increases in various cancers among those living near Rocky Flats disappeared. When Area I, the area closest to the Rocky Flats Plant, was compared to the whole Denver metropolitan area, no excess was found in either study period for either males or females for total cancer, radiosensitive cancer, or respiratory cancer. Crump et al. concluded that this study did not support a correlation between cancer incidence and environmental exposure to plutonium from the Rocky Flats Plant.

- The Colorado Central Cancer Registry (1998) compared the **incidence of cancer** for areas near the Rocky Flats Plant with cancer incidence in the remainder of metropolitan Denver. The report found that the incidence of all cancers combined was not higher than expected for each of the ten study areas nor for all study areas combined. The study also reported that the incidence of male lung cancer was higher

than expected in two of the study areas, but that of the groups showing increases, at least 75% were smokers. The state continues to monitor cancer incidence and will perform additional analyses as needed.

- The Rocky Flats Historical Public Exposures Studies was completed in September 1999. Of the 8,000 chemical and radioactive materials used at the Rocky Flats Plant, plutonium and carbon tetrachloride releases were the major contributors to off site exposures. Releases were highest in the late 1960's, and inhalation was the most important route of exposure. The key findings of the studies are summarized as follows:

  The largest releases of plutonium from Rocky Flats came from a fire at the plant in 1957 and from a waste oil storage area in the late 1960s. Between 10 and 50 curies (or between 130 and 670 grams) of plutonium were released to the air. It traveled off-site, predominantly east of the plant, as confirmed by measurements of plutonium concentrations in soil.

  People who lived near the plant and led active, outdoor lifestyles (such as ranchers or laborers) had the highest level of exposure to airborne plutonium and the highest risk. The increased risk of developing cancer for people with this lifestyle ranges between 1 in one hundred million and 1 in ten thousand, with a median value of 2.5 chances in a million. Researchers are confident that the true value for this risk has a 90 percent chance of being within this range. This risk is about the same as a person's increased risk from being exposed to the plutonium in fallout from U.S. weapons testing.

  Carbon tetrachloride, a solvent used at Rocky Flats for cleaning and degreasing, was the major chemical of concern released from the plant. Between 1100 and 5400 tons were released. The increased cancer risk for a rancher/laborer was estimated to be between 6 in ten million and 1 in one hundred thousand, with a median value of 2.5 in a million. This is comparable to estimated risk for plutonium exposure from Rocky Flats.

  An individual's location, lifestyle and period of exposure were found to have a greater effect on health risks than gender or age. For example, people who moved to areas near Rocky Flats after 1970 were exposed to much smaller concentrations of plutonium, and people who spent more time indoors had smaller risks than a person who worked outdoors all day.

  Other materials examined in some detail included beryllium, dioxin, uranium, and tritium. Health risks due to releases of these materials from Rocky Flats were considerably less than risks from plutonium or carbon tetrachloride.

The study concluded that cancer risks from all materials studied are low compared to cancer risks from other causes, and follow-up epidemiologic studies were not recommended. It was recommended that federal, state and citizen organizations actively monitor current and future operations at the site to prevent unnecessary off-site exposures from occurring in the future. More information on the studies is available through the Colorado Department of Health and Environment web site at www.cdphe.state.co.us/rf.

Studies of the Health of Rocky Flats Workers

- Previous epidemiology studies of workers at the Rocky Flats Plant discovered excess mortality from benign and unspecified brain tumors. The relationship between the brain tumors and various radiation exposures has been further investigated but remains unclear. Additionally, workers with higher amounts of plutonium intake were more likely than those with smaller amounts to have died from lymphatic and hematopoietic cancers as well as from all combined causes of death. These latter findings were not related to any measure of radiation exposure at the site. The Rocky Flats study is being updated with deaths through 1995 and with cancer incidence data. The study is expected to be completed in 2000.

What are the current studies and public health activities at Rocky Flats?

Community Involvement

- The Colorado Department of Public Health and the Environment has established the **Rocky Flats Health Advisory Panel** to provide guidance and oversight for the dose reconstruction project. The panel sponsored extensive public outreach and involvement activities, some of which will be increased in 1999 to interpret and promulgate study findings. Quarterly newsletters have described study progress and advertised panel meetings and other public meetings. Fact sheets and papers on technical topics have been produced to disseminate information and ask for input from stakeholders, and public meetings have been held. Panel members have spoken to many civic groups and are available to respond to questions.

Off-Site Contamination

- Patterned after the historical public exposure study and its oversight panel, another citizen panel is overseeing an **independent review** of the safe levels of radioactivity remaining in the soil after remediation. The panel is reviewing calculations used to determine how much radioactive material remaining in the soil will produce the allowable dose of 15 mrem per year to an office worker on site or 85 mrem per year to a hypothetical future resident living on the site. Citizens were concerned about the levels set for Rocky Flats because the rates appeared higher than for some other sites

and the citizens believed the rates were set without sufficient public involvement. This review should be completed in December 1999.

Occupational Health Studies

- Exposures encountered at Rocky Flats and other sites by **decontamination and decommissioning workers** are being characterized by the National Institute for Occupational Safety and Health (NIOSH). Working conditions and research needs are being identified at each study site in this Phase I feasibility study. These results are relevant to current workers, and the results support the development of surveillance activities.

- Under a NIOSH grant, the Colorado Department of Public Health and Environment, and the University of Colorado, are completing a **cancer incidence study**, an update of the **mortality study**, and a **nested case-control study of lung cancer**. These studies will determine if workers at the Rocky Flats Plant have elevated rates of cancer incidence or an increased risk of death from any disease as compared to the US population. NIOSH will also reevaluate worker doses to neutron radiation and internal radiation and will assess worker exposures to selected chemicals.

- Sponsored by a NIOSH grant, the State University of New York is conducting a **mortality study of female nuclear workers** at 12 facilities including Rocky Flats. This study will be the largest study of mortality among the 80,000 women ever employed in the DOE work force. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

- **Plutonium-induced lung fibrosis** has been observed in animals, but nonmalignant respiratory disease has not been studied in an exposed-worker population. Sponsored by a NIOSH grant, the National Jewish Center for Immunology and Respiratory Medicine is conducting a study to determine whether workers in facilities involving plutonium are at increased risk for developing fibrosis. Lung biopsies of Rocky Flats workers will be examined to investigate any association between lung fibrosis and exposures to plutonium-239 and other occupational exposures.

- The University of Colorado, under a NIOSH-funded grant, is supporting a project to create a system for **Sentinel Exposure Event Surveillance and Evaluation** at DOE sites. Based on a job/task evaluation and analysis, the sentinel exposure event (SEE) system incorporates exposure level measurements, worker-specific task definitions, and observational data such as controls and conditions or exposure into a special data recording and reporting system. This system is designed to produce reports for worker information programs and for the evaluation of occupational exposures in identifying and prioritizing intervention efforts. The SEE system has been developed

and implemented at the Rocky Flats site, and it will be evaluated for its applicability at other DOE sites.

- The **DOE Medical Monitoring Program for Former Workers at Rocky Flats Plant** reviews information to help determine whether former plant production workers might eventually have health problems due to their employment at the site. This project is being carried out by the University of Colorado Health Sciences Center. Phase I of this project included the collection and evaluation of existing chemical exposure data from the Rocky Flats site.

- Since 1991, DOE has been supporting a **Beryllium Surveillance Program** that provides medical monitoring program for workers who were exposed to beryllium during their employment at the Rocky Flats Plant. Medical examinations are provided to workers who think they have been exposed to beryllium and who volunteer to participate in the program. Those who are found to have lung problems are referred to a pulmonary clinic for a confirmed diagnosis. From June 1991 through December 1999, 8103 former Rocky Flats workers have been screened, with 68 being diagnosed as having chronic beryllium disease.

What are the gaps in our knowledge and what important issues need to be addressed?

- The risks to the general public from environmental plutonium exposures need to be determined. An example of potential exposure is the plutonium deposited in the silt of both Standley Lake and Great Western Reservoir within Operable Unit 3.

- Morbidity studies and non-cancer studies.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway which were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- ATSDR will continue to provide **health consultations** to DOE as requested. These consultations will evaluate and address specific questions regarding site remediation or community concerns. ATSDR will prepared an addendum to the health consultation

for Operable Unit 3. The addendum will address plutonium deposited in the silt of both Standley Lake and Great Western Reservoir and the possibility that disturbance of the silt may some day distribute the plutonium.

- The National Center for Environmental Health (NCEH) will work with the Colorado State Department of Public Health and Environment to complete important **follow-up tasks** from the dose reconstruction project. These tasks include the consideration of developing interactive software for determining individual risk, application of environmental monitoring data for validation of movement of plutonium in the environment, and the completion of the analysis of plutonium risk factors.

Public Health Activities Site Plan

Salmon Test Site

Lamar County, Mississippi

Background

In 1964 and 1966, two nuclear detonations were exploded in an underground salt dome in Lamar County, Mississippi. The Salmon Test Site (formerly called the Tatum Dome Test Site) is located 21 miles southwest of Hattiesburg, Mississippi. The salt dome is about 5,000 feet in diameter and 1500 feet below the ground surface. The Atomic Energy Commission selected the site for seismic experiments. The first nuclear detonation created a cavity in the salt dome that was used for a second nuclear detonation two years later. The first event consisted of a 5.3 ($\pm$ 0.5) kiloton yield nuclear detonation emploded 2,710 feet below land surface. The second event consisted of a 380 ton yield nuclear detonation. These detonations were contained within the salt dome; all environmental monitoring data for tritium (the source of radiation exposure) immediately after the detonations and subsequently have shown no increase above background levels.

Residents in the surrounding area recently raised concern about health effects, primarily cancer, related to the site. This study was initiated to determine if there was a relationship between cancer deaths in Lamar County and residence near the Salmon Test Site.

What have we learned from our studies and assessments of the Salmon Test Site?

Site and Off-Site Contamination

- Environmental monitoring activities have been conducted at the site since the first test took place in 1964. Reports by the Mississippi State Department of Health, Division of Radiological Health and the U.S. Environmental Protection Agency (EPA) indicated that there were no gas or particulate releases during any of the nuclear detonations. The U.S. Geological Survey and a private contractor conducted the testing. Results of these analytic tests showed no increase in the normal background radiation. The results of the monitoring program are documented in a report prepared by the U.S. DOE Field Office, Nevada (DOE, 1978) and in the 1990 annual reports prepared by the Environmental Protection Agency (EPA) and the Mississippi State Department of Health, Division of Radiological Health.

- A Long Term Hydrologic Monitoring Program was initiated by DOE and EPA when the Salmon Site was deactivated in 1972 and was conducted by EPA's Environmental Monitoring Systems Laboratory (EMSL) in Las Vegas. In 1977, the Mississippi

Division of Radiological Health became a participant in this cooperative monitoring program. The program was designed to regularly evaluate the test site and surrounding areas to ensure that residue left from the tests did not affect drinking water.

The Long Term Hydrologic Monitoring Program and the State of Mississippi have monitored all accessible wells, boreholes, creeks, and ponds on the 1,470 acre site since 1972. The EPA sampled ground water from 54 wells on and off-site and from 20 residential wells. Data from these analyses were compared to baseline data of samples taken when the test site was initially closed.

The results of this monitoring program are summarized as follows:

- Ground water monitoring indicated that the salt dome was intact and that no tritium was leaking from inside the dome.

- The tritium concentrations found in deep wells, both on and off the site, were similar to worldwide background levels.

- Low levels of tritium have been measured in water from shallow boreholes in the area where the tests were conducted. The water in these boreholes was brackish and undrinkable. The tritium found here was from residue brought to the surface by drilling activities conducted immediately after the tests. No health hazard was identified because the water was not used for drinking, the tritium concentrations were low, and the test site was off limits to the public.

- The highest tritium concentration was 48 pCi/L; the EPA drinking water standard for tritium was 20,000 pCi/L.

Community Health Studies and Activities

- A mortality study was undertaken by the Department of Energy to determine if there were excess cancer deaths among former residents in the area near the Salmon Test Site. The Public Health Statistics Division of the Mississippi State Department of Health, provided computerized data for all deaths among Lamar County residents (population about 27,000) between January 1, 1980, and December 30, 1991.

  A total of 562 (25.7%) deaths due to cancer and 1,623 deaths due to other causes were identified. There were too few cancer deaths among children to permit analyses. The analyses indicated that there was no apparent relationship between cancer death and residence near the Salmon Test Site. The risk of cancer was no higher for those living near the Site than for those living farthest away, nor those living in one direction

compared to another, although there was a non-statistically significant increase in those living north of the site.

The findings of this study are consistent with a previous investigation by the Mississippi State Department of Health in which they conducted an analysis of vital data records. The State study found that the age-adjusted mortality rates for all cancers combined and for 34 site-specific cancers for Lamar County were similar to those for Mississippi and other counties within the state for the period 1980–1988.

Studies of the Health of Salmon Test Site Workers

- There are no epidemiologic studies of former workers at the Salmon Test Site.

What are the current studies and public health activities at the Salmon Test Site?

- There are no current studies being conducted in populations near the site. The Mississippi Department of Health continues to monitor private wells quarterly, and DOE continues to do monitoring annually.

- A DOE report on remediation activities has been completed and is being reviewed by the State. DOE completed a mathematical model of ground water monitoring of the aquifer plume. The model did not suggest any off-site exposure.

- DOE completed a risk assessment around the site.

- DOE has agreed to fund the installation of a water system in the area. It will be more cost effective than continuing the water testing over the next 50 years.

What are the gaps in our knowledge and what important issues need to be addressed?

- No additional issues have emerged.

Public Health Activities Site Plan

Savannah River Site

Aiken, South Carolina

Background

The Savannah River Site (SRS) in South Carolina was constructed during the early 1950s to produce materials for the fabrication of nuclear weapons, primarily tritium and plutonium-239. During the years since construction, the operations at the site were adjusted to meet the country's changing defense needs. A major operational change at the site has been the permanent closure of the five reactors used to produce plutonium and tritium and a shift in the late 1980s to the recycling of this material to maintain the nation's supply of nuclear weapons. This recycling activity allows the United States to stretch its supply of tritium and reduces the need to produce more of the material. In addition, other production, storage, and recycling operations at the site are currently under review through an Environmental Impact Statement Process. The Savannah River Site is a Department of Energy (DOE) facility currently being operated by Westinghouse Savannah River Company.

Although tritium has been a long-time concern at the site, potential adverse health effects due to exposure to atmospheric and surface water releases of chemicals and other radionuclides from the site are also of concern. Routine and inadvertent releases occurred from the five reactors (100 area), separations facilities (200 area), and other operational facilities. Many community residents are also concerned about groundwater and environmental justice issues. Other residents are concerned about the health of workers at the site.

What have we learned from our studies and assessments of the Savannah River Site?

Off-Site Contamination

- The South Carolina Department of Health and Environmental Control, the Georgia Department of Natural Resources, and the US Environmental Protection Agency jointly issued a **fish consumption advisory** to provide guidelines for consumption of fish taken from selected portions of the Savannah River and Steel Creek, Lower Three Runs Creek, and Fourmile Branch. The initial advisory was issued in January 1995 and was based on mercury levels in fish samples taken from the Savannah River. As a result of additional sampling of fish in tributaries to the Savannah River, the South Carolina Department of Health and Environmental Control expanded their advisory in May 1996 to include fish in those creeks based on measured levels of cesium-137 and strontium-90.

- The National Center for Environmental Health (NCEH) is performing a **dose reconstruction study** to assess the dose and risk to the surrounding community from past exposure to contaminants released from the site. NCEH has completed two phases of the Savannah River Site Environmental Dose Reconstruction Project: document retrieval and assessment and the reconstruction of historical releases of radioactive materials and chemicals from SRS between 1954 and 1990. In Phase I all records stored at SRS and other locations were searched and interviews with current workers and retirees were conducted. Several thousand useful documents were found that could be used to estimate chemical and/or radionuclide releases to the air and water around the SRS. NCEH has recently completed a draft final report for Phase II: the *Savannah River Site Environmental Dose Reconstruction Project; Phase II: Source Term Calculation and Ingestion Pathway Data Retrieval Evaluation for Materials Released from the Savannah River Site*. During this phase, it was estimated that the key radionuclide releases to air were iodine-131, tritium, argon-41, iodine-129, and plutonium-239,-240. Key releases to water were cesium-137, tritium, strontium-90, cobalt-60, phosphorus-32, and iodine-131. Twenty-two key chemicals and heavy metals released to the water and air from the site were also identified. At the present time, none of the chemicals and radioactive materials released from the site have been determined to have migrated off site via groundwater.

Studies of the Health of SRS Workers

- In a recent multisite study, sponsored by a National Institute for Occupational Safety and Health (NIOSH) grant, the University of North Carolina found that there was an effect based on age. External doses received at older ages were associated with an increased risk of multiple myeloma, but doses at younger ages were not.

- The mortality experience of 9,860 white male Savannah River Plant workers was evaluated. They were reported to have a higher rate of leukemia than the U.S. general population through 1980. This was concentrated among hourly workers employed before 1955 who worked from 5–15 years. The leukemia death rate through 1986 was higher than expected only for those deaths occurring from 1965 through 1969. Preliminary findings from a recent study of Savannah River Site workers reported that the leukemia mortality rate was not higher than the U.S. rate through 1995.

- An Agency for Toxic Substances and Disease Registry (ATSDR) health consultation for the **D-Area seepage basin** determined that the dioxin levels did not pose a health hazard to workers if recommended worker precautions were taken during removal actions.

What are the current studies and public health activities at SRS?

Community Involvement

- NCEH and ATSDR will continue to work with the **Savannah River Site Health Effects Subcommittee**. The subcommittee serves as a vehicle for the public and tribal nations, including the Catawba Tribe of South Carolina, to express concerns and provide advice and recommendations on the agencies' public health activities and research at SRS.

- NCEH, in collaboration with ATSDR and the subcommittee members, is evaluating three of the current health effects subcommittees, including the SRS Health Effects Subcommittee, to examine how well these community/agency partnerships are working and how to better **improve stakeholder involvement** through the subcommittee process.

Off-Site Contamination

- NCEH will complete a screening analysis in **Phase III of the Savannah River Site Environmental Dose Reconstruction** to determine which contaminants and exposure pathways have the highest potential for causing harm to people (risk-based screening analysis). In **Phase IV**, NCEH will develop site-specific models and parameter values for those contaminants and exposure pathways selected in Phase III. These models will be used in **Phase V** to calculate environmental exposures and doses. A quantitative uncertainty analysis will be included for all of the Phase V calculations.

- Based on the results of the risk-based screening analysis, NCEH is collecting information needed to determine **potential health risks in the off-site community** that might be associated with past releases of radioactive and chemical materials from the site. Activities include selection of potential deleterious health outcomes, development of risk estimation models, and identification of critical knowledge gaps. This project will also include estimating the size and dynamics of the off-site population potentially affected by historic releases of radioactive and chemical materials and estimating community cancer risk resulting from these exposures.

Community Health Studies and Activities

- ATSDR, NCEH, and NIOSH staff members are coordinating the development of a community **health communication strategy**.

- ATSDR, NCEH, and NIOSH are working with local health and community representatives in Chatham County to review the information collected during the

1996 **community needs assessment** process and to assist with any necessary follow up.

Occupational Health Studies

- Two ongoing NIOSH case-control studies combine worker information from multiple sites, including SRS, to answer study questions about specific cancers. A case-control study is being conducted to clarify the relationship between **lung cancer** and external radiation exposure. The second case-control study, the largest of its kind, is exploring the relationship between external radiation and **leukemia** risk among 250 workers with leukemia compared to similar workers who do not have leukemia.

- Exposures encountered at SRS and other sites by **decontamination and decommissioning workers** are being characterized by NIOSH. Working conditions and research needs are being identified at each study site. These results are relevant to current workers and support development of surveillance activities.

- The mortality experience of **chemical laboratory workers** from multiple sites, including SRS, is being studied by NIOSH. Limited previous studies outside the DOE complex suggest an increased risk of cancer in these workers.

- Sponsored by a NIOSH grant, the State University of New York is conducting a **mortality study of female nuclear workers** at 12 facilities including SRS. This study will be the largest study of mortality among the 80,000 women ever employed in the DOE work force. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

- The **DOE Savannah River Site Former Production Workers Medical Surveillance Program** is conducted through the Medical University of South Carolina. The target population is former production workers at SRS who worked from inception in 1950 to the present. It is estimated that there may be approximately 25,580 of these workers. The hazardous substances that justify medical surveillance include asbestos, beryllium, dioxane, hydrazine, hydrogen sulfide, external ionizing radiation, internal radiation, noise, perchloroethylene, polychlorinated biphenyls, transuranium, and trichloroethylene.

- **The DOE Savannah River Building Trades Medical Screening Program** is conducted through the Center to Protect Workers' Rights. The target population is former and current building trades workers (building and construction workers) at SRS who worked from inception in 1950 to the present. The hazardous substances that justify medical surveillance include asbestos, cadmium, chromium, heavy metals, ionizing radiation, lead, mercury, silica, solvents, noise, and welding fumes. Beryllium and tritium are also being considered for medical surveillance, but more tentatively.

- The **SRS worker cohort** is being updated by researchers at the Environmental and Occupational Health Sciences Institute at Rutgers. Preliminary analyses indicate that the elevation in rates of leukemia mortality noted previously has been limited to the 1960s. Rates have dropped since then and are now slightly below US rates. Analyses are continuing.

What are the gaps in our knowledge and what important issues need to be addressed?

- Depending on the results of the environmental dose reconstruction, a determination may need to be made in the future of the potential health risks that might result from past exposures to chemicals and radionuclides released from the site to the communities surrounding SRS.

Applicable to SRS and other Sites

- Further epidemiologic research is needed to evaluate the protection against potentially adverse health outcomes in the workplace provided by current occupational radiation exposure limits. Many of these exposure limits were developed from bomb survivor and radiation therapy exposure data that differs in intensity, duration, route of exposure, and frequency from that found in the workplace.

- Internal dosimetry of radiation workers requires numerous assumptions and the relationship between internal radiation dose and health effects needs to be evaluated.

- Results from ongoing mortality studies need to be evaluated to improve understanding of causes of cancer and chronic disease. Additional studies can be proposed to focus on a single disease in worker groups.

- There is a need to ensure that complete records, including industrial hygiene and work history data for the various levels of subcontractors at each site, are available.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway which were listed previously and initiate the following new projects. Such activities will be implemented only if feasible and deemed appropriate and beneficial to the community. The agencies will establish a coordinated plan, schedule, and lead organization for each new public health activity. The plan and schedule will be presented to all potential partners for their comment.

New Activities for FY 1999 and FY 2000

- ATSDR will implement **health care provider training** for communities near the Savannah River Site. Primary care providers will be given information and resources to diagnose, treat, and counsel persons concerned about the health impact of the site.

- ATSDR, in collaboration with NCEH, will implement a **community health education** and communication strategy. The agencies will work with the Savannah River Site Health Effects Subcommittee, SRS Citizens Advisory Board, and the communities around the site to identify the community needs for information and education. Based on this information, a comprehensive health education outreach program will be developed.

- ATSDR will initiate work on the **public health assessment** for the Savannah River Site to (1) evaluate the potential for environmental exposures to the public (past, present, and future); (2) assess the impact on public health (past, present, and future); and (3) prevent and mitigate further public exposure. To avoid any duplication of effort, ATSDR will use the data and information collected by NCEH during their dose reconstruction activity.

- In accordance with Executive Order, ATSDR will make **environmental justice** part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

Public Health Activities Site Plan

Shipyards in the Naval Nuclear Propulsion Program

Background

The U.S. Nuclear Navy Shipyards (NNS) built the first nuclear-powered ship, the USS Nautilus, which went to sea in 1955. Since that time, the Navy has developed shipyard nuclear capabilities at Kittery, Maine (near Portsmouth, New Hampshire); New London, Connecticut; Norfolk and Newport News, Virginia; Charleston, South Carolina; Mare Island, California; Puget Sound, Washington; and Pearl Harbor, Hawaii. At each of these sites, nuclear-powered ships have been constructed, overhauled, repaired, refueled, or inactivated.

What have we learned from studies and assessments of nuclear naval shipyards?

Studies of the Health of Nuclear Naval Shipyard Workers

- A cohort **mortality** epidemiologic analysis of workers at the Portsmouth Naval Shipyard completed by the National Institute for Occupational Safety and Health (NIOSH) found no significant excess mortality from any cause. Later case-control studies of lung cancer and leukemia in this group of workers did have positive findings, however, the report states that these findings were not in all likelihood, linked to occupational radiation exposure. Excess lung cancer mortality was associated with workers with cumulative occupational doses of 1.0 to 4.999 rem. These same workers were also potentially exposed to welding fumes and asbestos. The relative importance of welding fumes and asbestos in the development of the lung cancers could not be determined. In the other case-control study, significant excesses of leukemia were found for welders and electricians, but no relationship was found between leukemia and radiation exposure.

- In 1991, researchers from the Johns Hopkins University, Baltimore, Maryland, completed an epidemiological study of the health of workers at the six Navy shipyards and two private shipyards that serviced Navy nuclear-powered ships. This study evaluated a population of 70,730 civilian workers over a period from 1957 through 1981, to determine whether there was an excess risk of leukemia or other cancers associated with exposure to low levels of gamma radiation.

  The Johns Hopkins study found no evidence to conclude that the health of people involved in work on U.S. nuclear-powered ships has been adversely affected by exposure to low levels of radiation incidental to this work. The overall death rate

among radiation-exposed shipyard workers was less than the death rate for the general U.S. population.

The death rate for cancer and leukemia among the radiation-exposed workers was slightly lower than that for non-radiation-exposed workers and that for the general U.S. population. An increased rate of mesothelioma, a cancer linked to asbestos exposure, was found in both radiation-exposed and non-radiation-exposed shipyard workers, although the number of cases was small.

What are the current studies and public health activities at the nuclear naval shipyards?

Off-Site Contamination

- There are no ongoing studies of off-site contamination.

Community Health Studies and Activities

- There are no community health studies for these sites.

Occupational Health Studies

- The NIOSH cohort **mortality** study of the Portsmouth Naval Shipyard, a mortality study of civilian employees at PNS, will be updated through 1997. Through an agreement with the Naval Sea Systems Command, the cohort has been expanded to include all individuals employed through 1992. Case-control studies will also be done, as indicated by a review of the data. The study will also determine whether external ionizing radiation is related to the risk of death from leukemia or lung cancer and whether asbestos exposure or other known carcinogens present at the shipyard are confounding these relationships.

- A case-control study for leukemia, the largest of its kind, is exploring the relationship between external radiation and **leukemia** risk among 250 workers with leukemia compared to similar workers without leukemia. About 250 leukemia deaths have been identified from four Department of Energy (DOE) sites and the Portsmouth Naval Shipyard. Confounding exposures to internal radiation, chemicals, and electromagnetic fields will be evaluated for all cases and controls.

- NIOSH will contribute study data from PNS workers to an international collaborative study of nuclear workers in 14 countries. This study is sponsored by the International Agency for Research on Cancer (IARC) and is **the largest cancer mortality study ever of nuclear workers**.

What are the gaps in our knowledge and what important issues need to be addressed?

- The Matanoski cohort mortality study of civilian naval shipyard employees, including those at PNS, was funded by DOE. The study followed approximately 70,000 nuclear Navy workers for 13 years, through 1981. An update of this study at this time would add at least 15 years of mortality data for this cohort. This is an important cohort to follow-up due to its size, the exceptional quality of the exposure information available, and since the radiation exposure to this cohort is without the confounding factor of internal dose.

Proposed Activities

Ongoing Activities

The agencies propose to continue the projects already underway that were listed previously.

New Activities for FY 1999 and FY 2000

- NIOSH will update the 1991 Johns Hopkins study cohort of naval shipyard workers.

Proposed NIOSH Occupational Studies

(Sites to be Selected Following Further Review)

The National Institute for Occupational Safety and Health (NIOSH) has study concepts approved in three categories for which sites have not yet been selected. The first category is for case-control and incidence studies that will further define the relationships between cancer and occupational exposures to ionizing radiation and chemicals at U.S. Department of Energy (DOE) sites. Although these studies will not start in FY 2000, during this year NIOSH will continue to evaluate emerging information pertinent to initiating these study efforts at a later date. The second category is the development of epidemiology data sources that will collect relevant information about cancer incidence and birth defects registries so that additional studies based on these health effects can be conducted. The third category of studies includes the development of research methods to expand the power of epidemiology research to detect relationships between forms of radiation exposures and disease.

Cancer Case-Control and Incidence Studies

Brain Cancer Case-Control Study

Previous mortality studies at the Los Alamos National Laboratory, the Oak Ridge Y-12 plant, and the Rocky Flats plant have found excess deaths from brain cancer, although the excesses were not statistically significant. Individually, these studies have lacked sufficient power to establish dose-response relationships because there were only a small number of cases at each site. Preliminary feasibility analysis indicates that sufficient brain cancer cases can be combined across DOE sites to investigate a possible relationship between brain cancer and exposure to ionizing radiation.

Bone Cancer Case-Control Study

A large number of workers at DOE facilities have been exposed to radioactive materials that, after inhalation or ingestion, concentrate in bone. Since bone cancer is a very rare disorder, previous studies of these workers have lacked sufficient power to detect statistically significant excesses. The fatal cases of bone cancer identified in the existing cohorts will be combined and matched with suitable controls to determine if there is a relationship between exposure to radiation and this disease.

Female Breast Cancer Incidence Study

Mortality studies of workers at DOE facilities have not included a sufficient number of breast cancer deaths to provide a dose-response relationship, in part, because of the small number of females included in each cohort analysis. By combining cohorts from a number of sites, and examining incidence rather than death, this study will substantially increase the power to

detect any associations between radiation exposures and breast cancer in female workers. If risk factors associated with breast cancer are identified, they may lead to early detection of breast cancer, which substantially improves prognosis and is known to have substantial life saving potential. A current NIOSH-sponsored study of female workers at 12 DOE sites may identify sites where this study can be conducted with the greatest power to detect a relationship, if one exists.

Development of Epidemiology Data Sources

Cancer Incidence and Other Sentinel Events Registries

Across the United States, numerous cancer incidence and sentinel event registries have been developed and maintained for a number of years. Many of these registries are in or near states where DOE sites are located. This activity will collect information from these registries so their potential value to examine relationships between occupational exposures at DOE sites and cancer incidence may be evaluated. Subsequent studies may possibly be designed which link the registry files with lists of workers at DOE sites.

Development of Exposure Assessment Methods

Neutron Exposure Assessment in DOE Cohorts

Methods for estimating and independently incorporating neutron exposure estimates in epidemiology studies will be developed. Human health effects which may result from neutron exposures are believed to be dependent on the magnitude of cumulative exposure, the dose rate, and the energy spectra of the neutrons. This study will evaluate historical neutron-monitoring practices and exposures at several DOE sites. Potential missed dose due to detector energy thresholds, monitoring frequency, and inadequate monitoring practices will be evaluated.

Internal Radionuclide Exposure Assessment in DOE Cohorts

Workers across the DOE complex have received doses from radioactive materials deposited in their bodies. For the first three decades of operations, monitoring programs were inadequate to estimate the doses received. As a result, these exposures may be confounders in the analysis of external radiation health effects in many previous studies. Information on these exposures that is specific to radioactive materials present at different sites will be collected and evaluated. Methods will be developed to include appropriate measures of dose or exposure in epidemiology studies of these workers.

Documentation of Dosimetry Practices

The uncertainty in risk estimates for radiation exposures is dependent on the interpretation of dosimetry data used in epidemiology studies. This study will identify, collect, and summarize historical dosimetry program documents at key DOE sites for which epidemiology studies are being completed. As these facilities close, site missions change, and personnel retire, the documents and process knowledge of dosimetry practices are at risk of being permanently

lost. This study will capture essential information needed to estimate historical exposures to ionizing radiation at multiple sites.

Exposure Matrix Data Sensitivity Analysis

In occupational epidemiology studies, job exposure matrices are often used to estimate past worker exposures to chemicals and radiation when there is actual measured exposure information for some workers, but not all workers. A job exposure matrix assumes that workers in similar job settings will have similar exposures. Any estimated exposure has an inherent degree of uncertainty. The large numbers of DOE workers with personal radiation dosimetry data provide an opportunity to assess the uncertainty associated with using exposure estimates developed from job exposure matrices. In this study, the direct measures of exposure for each worker and for groups of workers (their personal radiation dosimetry data) will be compared to exposure estimates that are developed using job exposure matrices. The matrices will be created with varying levels of actual and assumed worker information. The study will determine the degree of uncertainty of exposure estimates associated with each level of data completeness. Understanding the uncertainty within occupational epidemiology studies which have used job exposure matrices will improve interpretation of the study findings.

ATSDR Multi-Site Activities

Toxicological Profiles

Toxicological profiles are available for many chemical and radioactive substances, including plutonium, radium, radon, uranium, and tritium. ATSDR will prepare toxicological profiles for the elements and their radioactive isotopes that are listed in the following table (americium, cesium, cobalt, iodine, and strontium). These substances were released during past or current operations at various DOE sites and may still be present. Other elements, such as carbon and barium, will be considered for profiling in future years.

A toxicological profile is a publicly and scientifically reviewed report that provides a consolidated summary of available knowledge about a chemical or substance and the human health consequences of exposure. Toxicological profiles identify the full range of health effects, by duration and route of exposure, observed in animals and humans from exposure to particular substances. They contain relevant information on chemical, physical, and radiological properties; production, import, export, use, and disposal; pathways migration; potential for human exposure; analytical methods; regulations and advisories; and toxicological data gaps for which additional research is needed. They also derive health guidance values or route and duration-specific exposure concentrations that are expected to be without significant human risk. Profile recipients include a wide range of groups in the private sector, other Government agencies, the international community, and academia, as well as citizens and environmental groups. They are used as an authoritative source of up-to-date information on the health effects of hazardous waste components, as a guide to health assessors working at hazardous waste sites, and as a tool to educate the public about the potential for health effects. Federal agencies, such as DOE, can use toxicological profiles to make better informed decisions at their sites.

Contaminants Released During Previous or Current Site Operations					
	Americium	Cesium	Cobalt	Iodine	Strontium
Brookhaven	X	X	X	X	X
Fernald		X			X
Hanford	X	X	X	X	X
INEEL	X	X	X	X	X
LEHR		X			X
Lawrence Livermore (LLNL)	X	X	X		
LLNL 300 area		X			
Los Alamos	X	X	X		X
Nevada Test Site	X	X	X	X	X
Oak Ridge	X	X	X	X	X
Rocky Flats	X	X			
Savannah River Site		X	X	X	X

Toxicology of Mixtures Research

ATSDR proposes a two-step project for determining how radiation affects toxicity during co-exposure to other chemicals. In the first step, appropriate mixtures will be identified, and in the second step, the toxicity of these mixtures will be assessed in combination. Data from DOE sites will be reviewed to identify candidate radioactive and non-radioactive substances that individuals might be co-exposed to and which could impact common target organs, such as the kidney or liver. Relevant literature searches will be conducted to compile known information, if any, on combined toxicity of the substances in mixtures. Based on these findings, scientific assessments will be designed and conducted to answer specific questions concerning the role radiation might play in increasing or decreasing adverse effects of the chemical mixture on the overall health of human populations exposed in the vicinity of DOE sites.

Phase I of the project will identify pertinent mixtures found at DOE sites through contracts, grants, and staff activities. Preliminary data analyses have already identified several 3- and 4-component mixtures likely to be present at DOE sites. A more comprehensive list will be developed and assessed to identify those mixtures that are found in completed exposure pathways, i.e., those to which the public is or has been exposed. Literature reviews will be conducted and findings summarized in interaction profiles to document interactions between the components of such mixtures that can impact the health of exposed human populations. Hypotheses will then be generated regarding interactions between mixtures of certain key chemicals and radioactive materials.

Phase II of this project will subject the above-generated hypotheses to scientific testing and assessment, and extend our current work efforts to mixed exposures from radioactive and chemical mixtures. Relevant multi-radionuclide and multi-chemical mixtures will be separately researched to identify the respective radiological and chemical health impacts, and jointly assessed for evidence and type of interaction. Results will be used to refine the hypotheses for general applicability.